POWER PLANT ENGINEERING

THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

TECHNOLOGY DEPT.

Wartime Training Of Plant Personnel

J. A. KRUG, *Director*, Office of War Utilities • N. E. FUNK, *Vice President*, Philadelphia Electric Co.

The Topping Program At Sherman Creek

How To Operate Large Boilers

Capacitors Play Vital Role In War Work

Typical installation of an Elliott marin type deaerating feedwater heate Hundreds of these units are toda serving America's sea-going powe plants. They are built to operate eff ciently under the special conditions o marine service.

ONE OF AMERICA'S GREAT BUILDERS O

STEAM TURBINES
GENERATORS

STEAM JET EJECTORS
MOTORS

FEEDWATER HEATERS
AND DEAERATORS

RIFUG
ENSE

...en the power plant

The slamming roar of the big guns is dulled to heavy thuds, in the strained quiet of below decks, while the big battlewagon sways to the recoil of tons of metal starting their flight toward the enemy.

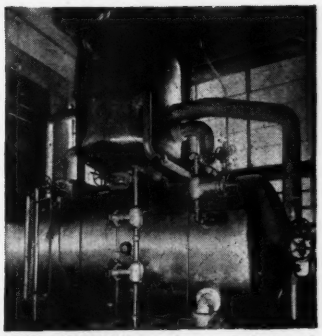
In the ship's power plant there is a tensity, a supreme watchfulness of equipment, dials, indicating instruments, and a split-second response to orders transmitted from above. Engineer officers and their staffs are winning the battle just as surely as the men at the fire-control stations. And their equipment must function positively. In the stress of battle, there must be no power failure.

So Elliott deaerating heaters, serving in Uncle Sam's fighting ships, must be—and are—as dependable in their performance as the very guns themselves. They help to win battles by heating boiler feedwater to the highest possible temperature and, by deaeration, preventing corrosion troubles in boilers, piping, and turbines.

They help to win battles on land too. On the home front in the nation's power plants, deaerating heaters have long been essential equipment. They are doing their part in the battle of production.

ELLIOTT DEAERATING FEEDWATER HEATERS

are working in steam plants of all kinds, ashore and afloat. They heat the water to the saturated temperature of the steam supplied, at the same time accomplishing the removal of corrosive gases. They are fully automatic, requiring no control or adjustment. They are the successful result of Elliott Company pioneering in the realm of deaeration beginning 24 years ago. Elliott engineers are glad to work with you today toward getting the best possible heat balance set-up for your plant. Full details and bulletin upon request.



Elliott 400,000 lb. per hour unit designed for operating pressure of 100 lb. gage. One of several such units in a large utility plant.

ELLIOTT Company

Deaerator and Heater Division

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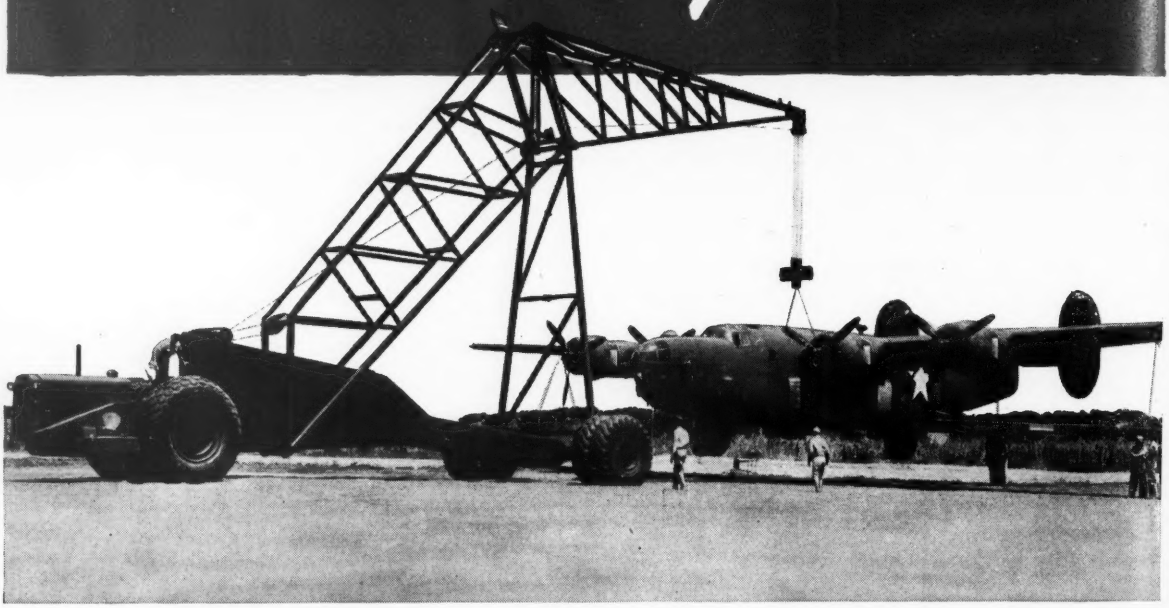
ARMY (E) NAVY

N-974

Mechanical Sky-Hook



KEEPING runways clear for take-offs and landings of fighters and bombers, is the specialized job of this giant "Tournacrane" powered with a Cummins Diesel. This new and interesting mobile crane is typical of the many important wartime uses of Diesels.

To keep Diesels at maximum efficiency, not only in the service of our Armed Forces, but in war plants, lighting plants, pumping stations, etc., operators everywhere are lubricating them with Texaco.

Texaco Algol or *Ursa Oils,* for example, keep engines *clean.* Their use assures long life of bearings, pistons and liners, free rings, compression-tight seal, full power, and *fuel economy.* Due to operators' success with it—

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★ More buses, more bus lines and more bus-miles are lubricated and fueled with Texaco than with any other brand.

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

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Engineering Editor
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KINGSLEY L. RICE
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Advertising Representatives

CHICAGO: Charles S. Clarke
53 W. Jackson Blvd., Chicago 4, Ill.

NEW YORK: John A. Kershaw
Graybar Bldg., New York 17, N. Y.

PHILADELPHIA: H. G. Wilds
121 Waverly Road, Wyncote, Pa.

CLEVELAND: A. H. Van Duyn
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FRONT LINES

HE IS NOT WORRIED (or, as Time would gargle it, not worried is he) about the immediate post-war era in the United States, Alfred P. Sloan, Jr., chairman of General Motors Corp., told a meeting of businessmen and Army and Navy officers in Chicago some time ago. He is, however, considerably concerned about the distant future. The nation, he declared, faces a post-war period in which it will take at least five years to catch up with the accumulated consumer demand for goods. His own corporation, he said, anticipates that instead of producing and selling 10,000 automobiles every 24 hours, as before the war, it can build and market 15,000 units a day. The letdown will come when this pent-up buying power has been exhausted, unless private enterprise is able to draw blueprints for winning the peace. He urged the government to make a frank statement of policy now regarding its peacetime intentions, to enable industry to plan intelligently. Just how the government could rightly commit the country to policies rigid enough for this purpose, Mr. Sloan did not say.

THE ROLE of industrial research in winning the war and planning the future was the keynote of a recent two-day program dedicating the new Goodyear Research Laboratory at Akron, Ohio. The laboratory contains the newest and most powerful tools of scientific research, such as the electron microscope, the analytical spectrograph and the infra-red spectrometer. At this ceremony, leaders of American science and industrial research took part in a series of four symposiums on the subjects of synthetic rubber, plastics in war and peace, the future of chemistry, and the future of transportation. At the moment, the Goodyear Co. has one customer, the United States of America, but when it is able to go back to the job of serving its millions of civilian customers, it looks to this new laboratory to play an important part in enriching American life. The chief objective of the program for the new laboratory will be to improve the quality, value, and serviceability of rubber tires of all kinds. It will, however, carry on research in many related fields including rubber and plastics, also in both heavier-than-air and lighter-than-air craft and various branches of metallurgy. Studies will also be made of the use of transparent films for packaging food and the like.

NOW THAT the submarine menace is lessening, the British and ourselves may be able to take advantage of the tremendous supply of iron ore available from the British colony of Sierra Leone on the west coast of Africa. At Marampa, a great hill of ore was found about 10 yr ago by a group of Scotsmen who developed it with very little assistance from Great Britain, which at that time was getting all the iron desired from Sweden at a low price. The ore is mined and transported by rail to Pepel on the west coast of Africa, about 52 mi away. The railroad can handle 5000 tons a day. Beyond Marampa is another and bigger mountain of iron, which has not yet been touched.

THE AVERAGE AMERICAN SOLDIER in the European-African theatres, said Drew Middleton not long ago in the New York Times, has a single peace aim: to get home to his job and his family and forget about the rest of the world and the war. The men want to get back to the same kind of world they knew in 1939. Very few of them realize, says Mr. Middleton, that it can never be the same kind of world again. Members of the 1917 A.E.F. will understand the reason for this feeling, whether they think it is right or not, Also, a few of them will understand the consequences of it. Here is another interesting thing. Herb Graffis, of the Chicago Daily Times, some time ago questioned a number of service men about their post-war plans. One of their principal ambitions, he found, was to get back home, marry the girl, and get started in some kind of small business of their own. On the other hand, Senator Thomas of Utah says "It may be well not to try to tell the returned soldier too much. He may have something to tell us. He may come home with more altruism than many of our less idealistic and more practical people think." We respectfully call the foregoing ideas to the attention of all post-war planners.

VOCATIONAL training enrollment in the United States shows a steady increase, according to the latest figures available from the U. S. Office of Education. Enrollments in Federally-aided regular vocational classes reached 2,629,733—an increase of 200,689 over enrollments in 1940-41. Of the total, 610,050 were in vocational agriculture classes, 850,597 in trade and industry classes, 954,041 in home economics classes and 215,049 in distributive education classes. Enrollments in the program of Vocational Training for War Production Workers continue to increase. Since July 1940, there have been 4,555,826 enrollments. In March, 1943, 287,396 persons were being trained. There is an increasing tendency on the part of war production employers to hire beginning workers and refer them to the public vocational schools for short intensive courses. Many of the new trainees are women. The program of Vocational Training for Rural War Production Workers since December 1940 has had a total enrollment of 945,926. In March, 1943 there were 172,666 enrollees.

WHEN STEEL SPRINGS go to war—no bounce, no armchairs, no davenports—no sale! So the furniture manufacturers got busy and developed wooden springs. Heywood-Wakefield Co. of Gardner, Mass., developed elliptical wood springs that do not require redesigning of existing furniture. Considerable work in the development of wooden springs had already been done by L. Moholy-Nagy at the School of Design, Chicago. He advocates treating wood as a new material and not imitating the designs of other materials in wood. Wooden springs of his design are to be manufactured by the Seng Co. The Nachman Spring-Filled Corp. of Chicago has also developed a new seat construction of pre-formed laminated material held together by wooden strips.

IRONICALLY ENOUGH, America and Britain are now solving one of Germany's post-war problems by bombing, points out the Chicago Daily News. With all that rebuilding to do, there'll be no lack of jobs in Germany. That also applies to Britain. Lest we Americans kid ourselves into thinking that we'll be sitting pretty after the war, sitting on top of the world, let us take account of one fact—the rebuilt industries of Europe will be new. They will be free of the handicaps of obsolescence and of the claims of past investment that have always handicapped older industrial regions in competition with new industrial systems.

AT THE RATE production of high-octane aviation fuels by alkylation, polymerization, hydrogenation, various fluid and solid catalytic processes is going ahead, at the expense of kerosene and distillates, suitable Diesel fuels will be on the critical list by 1944, C. M. Larson, Sinclair Refining Co. told the recent SAE meeting. Here is how the conversion of a 55,000 bbl per day refinery is affected by making 4000 b/d of 100 octane gasoline.

Products-Barrels per day manufactured

	Without 100 octane manufacture	With 100 octane manufacture
Gasoline		
72 octane*	13,000	13,000
80 octane*	8,000	8,000
100 octane*	none	4,000
Kerosene (No. 1)	4,000	3,000
No. 2 Fuel	8,000 (50 cetane)	5,000 (40-45 cetane)
No. 4 Fuel	1,000 (40 cetane)	none
Residual Fuel (Industrial)	20,000	20,000
Misc. and gas	1,000	2,000

*Leaded value.

APPLICATION to operate helicopters of large carrying capacity has been filed with the Civil Aeronautics Board in Washington by the Greyhound Corp., operator of surface busses. These helicopters will be intended for use as air busses to connect larger cities and towns and to supplement the regular highway bus. Plans have been developed to such an extent that a proposed air bus map of the country has been drawn.

POWDER METALLURGY is not new but its development since the war started is a mechanical miracle. Machine parts that can be produced in no other way are pressed from powdered metal. A dramatic example is the self-lubricating bearing that sucks up oil as a sponge absorbs water and gradually doles it out again during a long lifetime. These bearings are made porous by adding a volatile to the powdered metals. During the heat treatment the volatile burns out, leaving a network of tiny reservoirs which hold oil up to 35 per cent of the volume of the part. Squeeze one of these bearings in a vise and tiny drops of oil exude from its pores; release the pressure and the oil is sucked up again. In sub-zero climates, the self-lubricating bearings are not affected, and they do not bleed their oil in desert heat. Powder metallurgy's most spectacular triumph, however, is the tungsten-carbide cutting tool. Tungsten cannot be cast or machined like softer metals but it can be mixed in powdered form with other ingredients, pressed into shape and baked. One result is a tool that will heat to 3000 F without losing its cutting edge.

AVAILABILITY of new materials and machinery after the war will radically change railway freight equipment, increase railway electrification and use of Diesel engines, and improve freight cars, said Morris P. Taylor of the Southern Pacific Co. at the recent semi-annual ASME meeting. Coal is plentiful in this country. The petroleum situation is more confused. Any change from the pre-war surplus position will intensify cracking, which may reduce supply of Diesel oil fractions, also bunker oil for steam locomotives. Electric power will be plentiful in the post-war era, with large blocks available at very low rates, especially in the West. The present steam locomotive will be further improved in efficiency and reliability, but due to the narrow temperature limits between which it operates, will never be a high efficiency machine. However, due to low first cost, it will continue to be used extensively for seasonal and limited traffic or where cheap coal is available. The Diesel-electric locomotive has many advantages for freight service, and its use will expand, for it is powerful, smooth, efficient; present freight units are about 25 per cent overweight, which excess will be eliminated in post-war era by improved design and materials. However, the future of Diesels is tied up with the petroleum situation, and Diesel fuel may be less plentiful. With low interest rates, cheap power and aluminum, vacuum tube converters, and other developments, plus decreasing abundance of petroleum, many Western Lines may find electrification profitable. The combustion turbine and the steam-electric turbine, especially with mercury top cycle, have possibilities; particularly the mercury cycle; any unit that could get high thermal efficiency on powdered coal would cut fuel costs way below the Diesel, except on the Pacific Coast. House cars (box, etc.) will be made of welded alloy steels or light metals, and of glued wood and moulded plywood. Underframes will be of welded alloy steels or light metals. Open top cars to handle coal, ore, etc., will be made of corrosion- and abrasion-resisting steel, welded. Tank cars will be of welded tubular construction of alloy steel. Probably the most radical changes will be in freight car trucks, which are being redesigned to reduce weight and improve high speed riding and such developments will be further advanced when post-war materials become available. Draft gears and springs will be redesigned to include rubber and hydraulic characteristics to reduce shocks under all conditions.

AN OIL FIELD less than 100 mi below the Arctic Circle in Northwest Territory will help supply gasoline and fuel oil needs of the Army and Navy in Alaska and Canada, according to a recent disclosure by the War Department. A pipe line will move the oil from the Norman Wells field, near Fort Norman, some 600 mi westward to a refinery at Whitehorse on the Alaska Highway. There it will be converted into high-octane gasoline for planes operating out of Alaska bases and into fuel oil for naval craft in the Alaskan area.

VETERANS of the last war will learn with envy says a news correspondent, that by sprinkling an entirely new powder in their clothes, American troops in Africa kept themselves practically free from lice. Whadda ya' mean, practically? Either ya' got 'em, buddy, or ya' ain't! It's like there's no such thing as a practically fresh egg.

BETTER ELECTRIC WELDED STEEL TUBING

PRODUCED ON AMERICA'S MOST MODERN TUBE MILLS

For your wartime applications requiring greater strength and lighter weight, Talon's Electric Welded Steel Tubing is being produced in ever increasing quantities. Sizes now available for reasonably prompt delivery range from ¾" to 4" O. D. in lengths up to 40 feet. It is cold-formed from strip steel on the most modern, precision controlled equipment in existence. Since the accurate gauge and width of the flat-rolled strip are controlled by very close tolerances, the O. D. and I. D. of the finished tube are concentric.

As no extra metal is added in the welding process, the grain structure of wall and weld is homogeneous. Physical properties are further improved by atmospheric annealing; this also produces a scale-free, bright finish which hides no defects on either inside or outside surface. Maximum strength of Talon's Electric Welded Steel Tubing is assured by hydrostatically testing every foot of pressure tubing for safety and by carefully inspecting mechanical tubing to meet your own individual requirements. Hence, Talon's Electric Welded Tubing meets A. S. M. E., S. A. E., A. S. T. M., A. B. S. and all standard government specifications.

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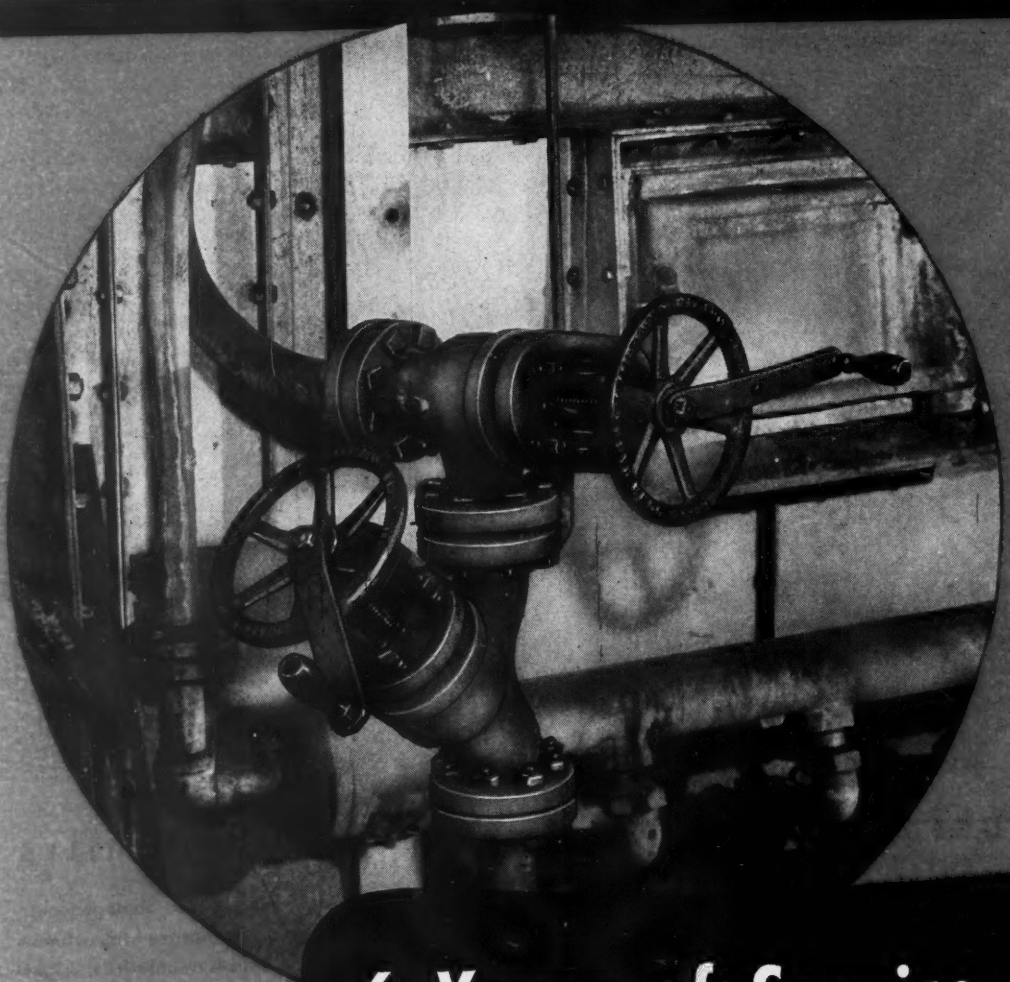
STEEL TUBE DIVISION OIL CITY, PENNA.

The Proof of The Pudding



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28 Yarway Seatless
Valves Still "Drop-Tight"

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at WYANDOTTE

THAT is the story at Wyandotte Chemicals Corporation's Michigan Alkali Div. Power Plant.

Such evidence of satisfactory service needs little comment—is ample proof of the soundness of design and metallurgy known and appreciated by more than 12,000 Yarway Blow-Off Valve users.

Eight Yarway Unit Tandems are used in the new Integral Furnace Boiler—five on main boiler blow down lines and three on water-wall drains —for these valves are equally suitable for blowing or draining and sealing.

Why not look into this finest Yarway high pressure blow-off valve—the valve that has made such records as, "3000 blows at more than 1300 lb boiler pressure, without replacement of a single part or repairs of any nature," in the plants of leading utilities and industries.

There is a Yarway Blow-Off Valve for every pressure, purse and purpose.

Write for Catalog; section B-422 for pressures up to 400 lb, section B-431 for pressures up to 2500 lb.

YARNALL-WARING COMPANY
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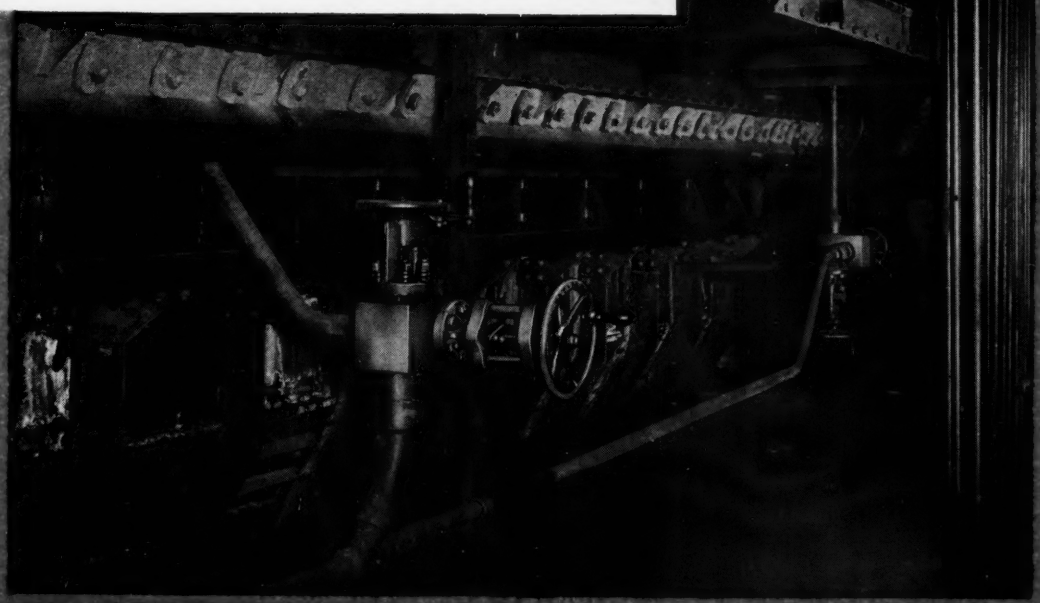
The Natural Selection was YARWAY UNIT TANDEM Blow-off Valves for New 1000psi Boiler



BLOW-OFF VALVES

23 years of steady, trouble-free service is record of MONEL trimmed main steam gate valves in Springdale Station, West Penn. Power Company

In 1920, four main steam gate valves with Monel stems, seats and discs were installed in the #1 steam header at the Springdale Station of the West Penn. Power Co. They were made by the Chapman Valve Manufacturing Co., Indian Orchard, Mass., per specifications of Sanderson & Porter, consulting engineers, and the Power Company.

A few years ago the steam header installation was changed. A new topping unit was added and the piping was altered.

The valves . . . which had already given constant, trouble-free service for about two decades . . . were put back in the line.

Today they are still in steady operation—after 23 years . . . with no attention except occasional renewal of the gland packing.

This service record is not unusual. It is a typical example of how Monel parts . . . installed by foresighted engineers long before the war . . . are now providing a "bonus" of long, trouble-free service for today's heavier power plant operation. The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

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HERE'S WHAT dirty discharge valves can result in: *Leakage of air, decreased capacity, lower efficiency, higher discharge temperature.*

For assurance of clean valves—use the correct oil.

The oil—carried past the valve by the compressed air—coats it with a necessary oil film. The oil must not oxidize on this "hot spot." That is why it must provide:

1. High chemical stability—freedom from deposit.
2. High lubricity—full protection to piston and cylinder with minimum feeds. This minimizes the amount carried to the discharge valves, further safeguarding against deposits.

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Vick Chemical converts to IRON FIREMAN

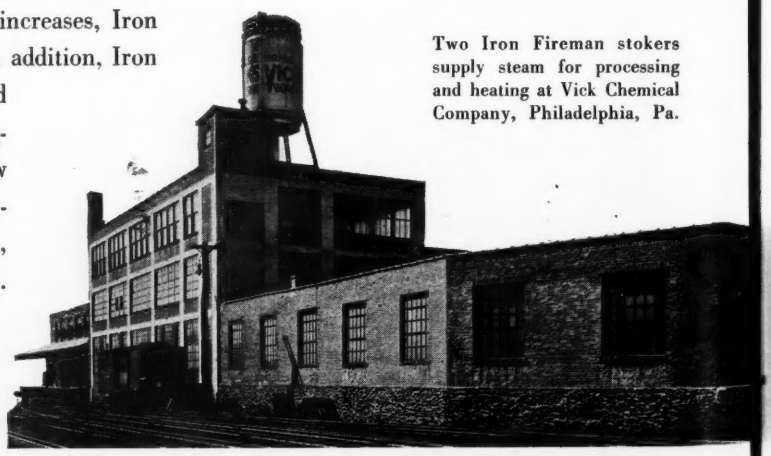
Averts Threatened Fuel Shortage

THE executives of the Philadelphia plant of Vick Chemical Company decided that conversion to coal, America's plentiful fuel, was necessary to insure continuous operation. Steam is required for processing, heating water, air conditioning, humidifying and heating the building.

Iron Fireman automatic coal stokers were installed in August, 1942. Near-record cold weather this past winter made the heating load larger than usual, and steam requirements for manufacturing were greater than ever before. In spite of these increases, Iron Fireman stokers handled the load. In addition, Iron Fireman's automatically controlled firing met the problem of rapidly changing steam requirements for cooking raw materials. It has cut fuel costs, thus reducing coal tonnage, transportation, and thereby aiding our war program.

Easy to Change to Iron Fireman Coal Firing

If you are faced with fuel changes or increased steam loads, find out how quickly Iron Fireman equipment can be installed. Iron Fireman engineers are ready to make an immediate survey of your steam plant. No obligation. Iron Fireman Manufacturing Company, Portland, Oregon; Cleveland, Ohio; Toronto, Canada.



Two Iron Fireman stokers supply steam for processing and heating at Vick Chemical Company, Philadelphia, Pa.

IRON FIREMAN
THE IRON FIREMAN
Automatic Coal Stokers

Sufficient space was not available at the front of the boiler and the Iron Fireman stoker was installed through the side of the furnace.

"Our Iron Fireman automatically controlled coal stokers now handle a rapidly fluctuating load that is even larger than the demand which was carried by our former firing system."

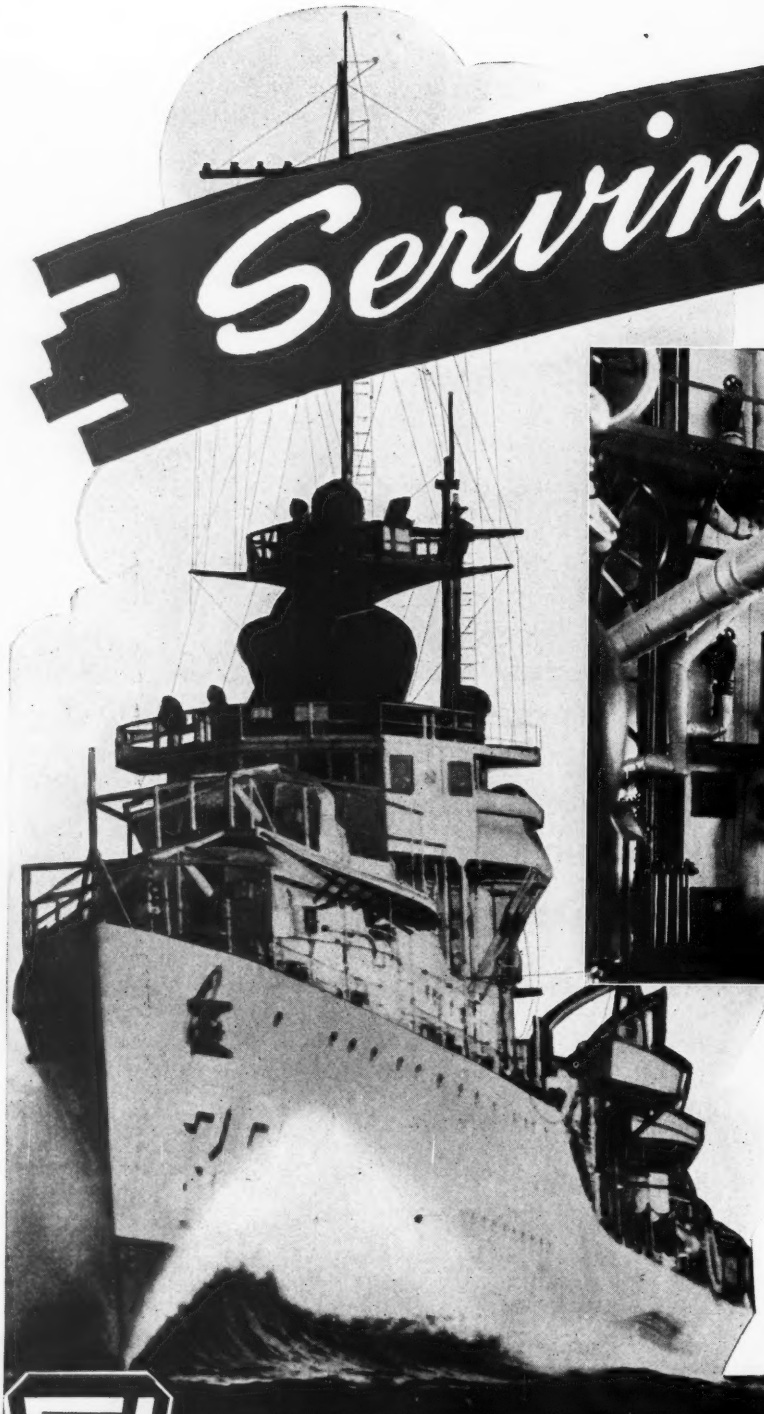
James Wood
Power Plant Supervisor
Vick Chemical Co.

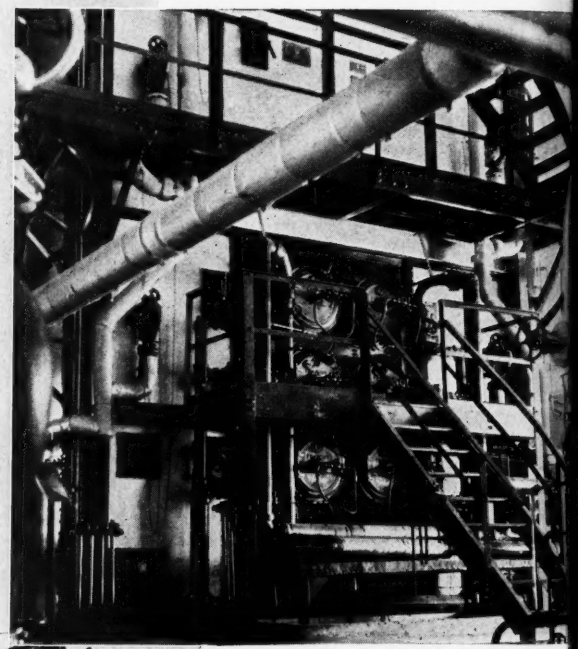
JAMES WOOD, *Power Plant Supervisor* at the Vick Chemical Company plant.

IRON FIREMAN STOKERS ARE AVAILABLE—*Write for Information*

Output of Iron Fireman commercial and industrial stokers has been substantially increased to equip heating and power plants converting from oil, hand-fired coal and gas. Our nationwide organization of qualified factory representatives and dealers is at your service. Write for literature. Iron Fireman Manufacturing Company, 3519 West 106th Street, Cleveland 11, Ohio.

Serving on





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★ From destroyers to battleships—a craft carriers to inland waterwa towboats—Foster Wheeler mari steam generators are in the fig for Liberty.

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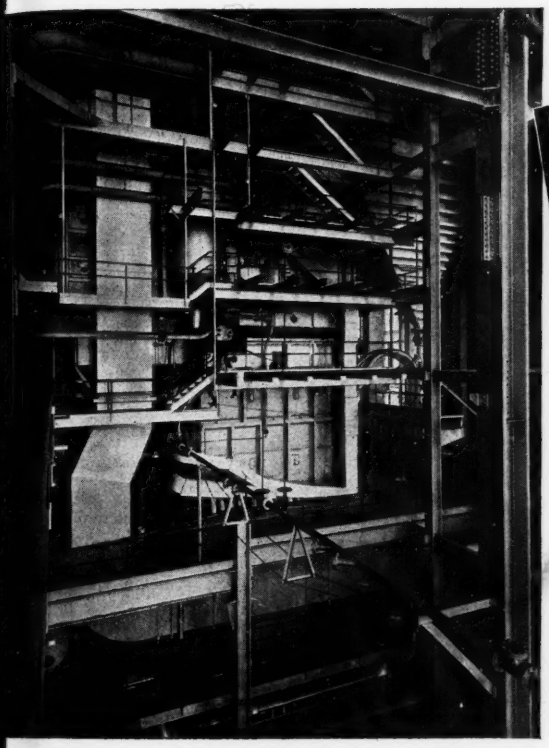
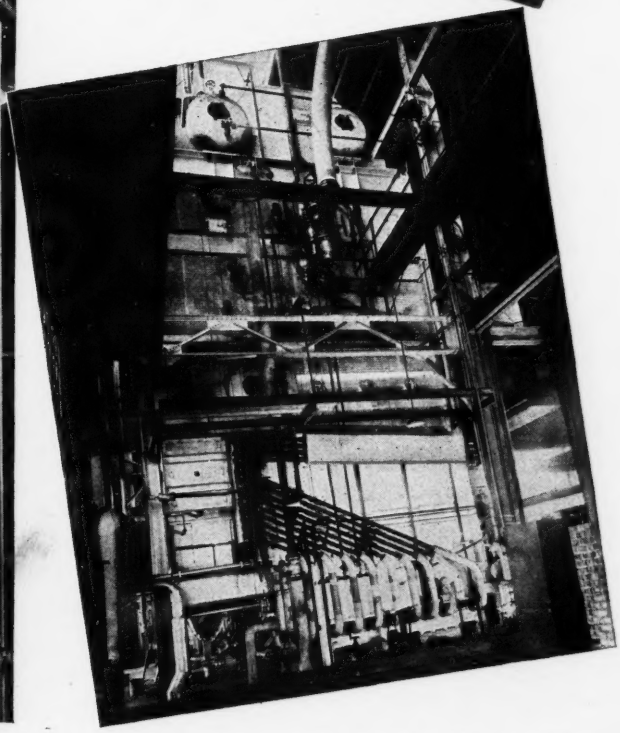
LAND and SEA



★ **PUBLIC UTILITY**—Three-drum steam generator with superheater, economizer, and tubular air heater; capacity 400,000 lb. of steam per hr. at 880 p.s.i. and 900 deg. F. Fired with pulverized coal.



★ **INDUSTRIAL PLANT**—Three-drum steam generating unit of 210,000 lb. of steam per hr. capacity, at 275 lb. per sq. in. pressure and 520 deg. F. Stoker fired.

IN addition to hundreds of marine boilers for the Navy, Coast Guard and Maritime Commission, Foster Wheeler, since Pearl Harbor, has built 138 stationary boilers ranging in capacity up to 500,000 lb. of steam per hour.

40 for CHEMICAL PLANTS
19 for ORDNANCE PLANTS
16 for OIL REFINERIES
10 for OTHER WAR PLANTS
10 for PUBLIC UTILITIES
43 for EXPORT TO ALLIED NATIONS

FOSTER WHEELER CORPORATION . . . . 165 BROADWAY, NEW YORK 6, N. Y.

WHEELER

Progress and Power in the

In America's great aircraft industry which is producing at a record speed undreamed of in history, American Blower products are performing vital roles. Heaters for hangars, fly ash collectors for flying field heating plants, fans and dehumidifiers for air conditioning, heating, ventilating and distributing air in hangars, plane and engine plants, special equipment that makes possible revolutionary new processes, and even Fluid Drives for many of the planes themselves, are being produced in record quantities at American Blower's great factories. In the Public Utilities, whose plants are being taxed to capacity to furnish the load for the production of war materials, American Blower Mechanical Draft equipment, Collectors and Fluid Drives are meeting every test. Till Victory—making the machines of war hum is our job. After Victory—remember, you can always depend on American Blower equipment.

AMERICAN BLOWER

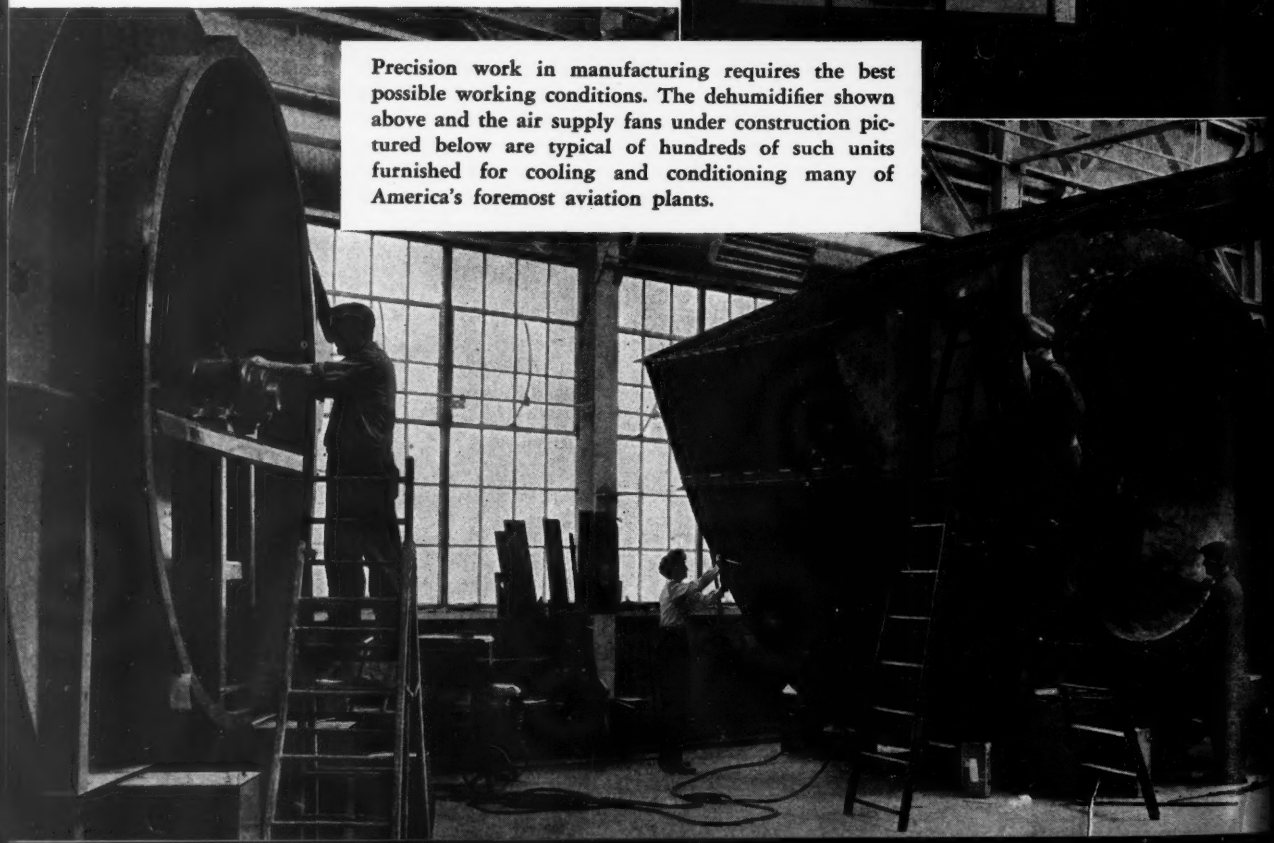
ARMY E NAVY

For Production "Well Done"

AMERICAN BLOWER CORPORATION, DETROIT, MICH.

CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT.

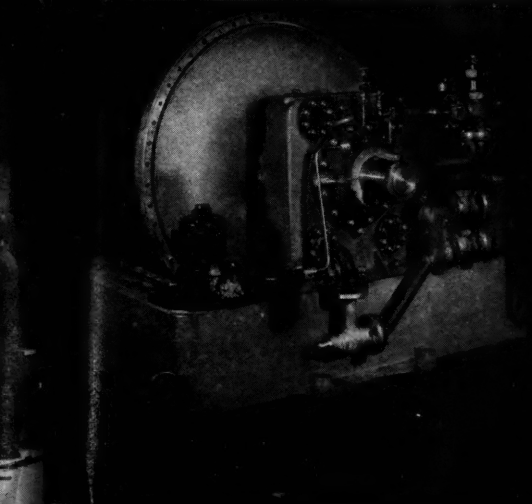
Division of American Radiator and Standard Sanitary Corporation



Precision work in manufacturing requires the best possible working conditions. The dehumidifier shown above and the air supply fans under construction pictured below are typical of hundreds of such units furnished for cooling and conditioning many of America's foremost aviation plants.

AIRCRAFT INDUSTRY!

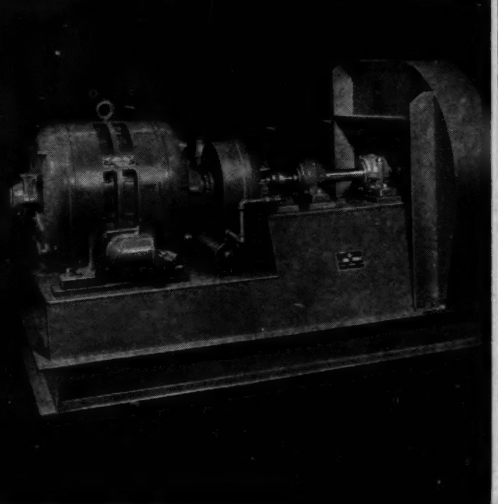
American Blower fans such as this one are used extensively in the aircraft industry for numerous testing purposes and to supply air at high velocity in wind tunnels.



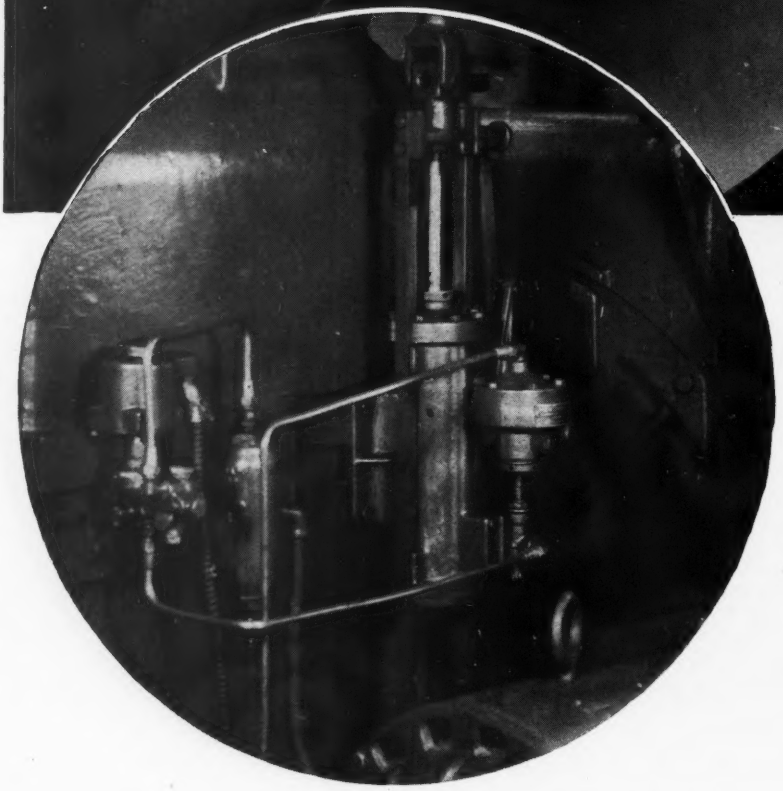
American Blower Fluid Drives are performing many vital functions in the aviation industry. This particular unit (left) is one of many used for running-in and power testing aircraft engines.

• • •

The high pressure fan (right) with Fluid Drive Variable Speed Control is used to supply conditioned air to carburetors on test.



"Trigger-quick"



STEAM LOADS JUMP ALL OVER THE MAP in this large steel mill, as can be seen from the load and pressure charts. But notice how fast the boilers respond, maintaining pressure within a few pounds.

★ ★ ★

FAST RESPONSE FROM STOKERS is assured by this Hagan Stoker Speed Control which feeds coal at the exact speeds required to furnish the necessary amounts of steam. Note simplicity and accessibility.

response of Hagan Control

gives you MORE STEAM the instant you need it

STEP on the gas in your automobile and you get instant response. If you didn't, you would soon be looking for another car. That's the kind of action Hagan Control brings to your boilers—and it's all automatic.

Big load shifts or small get instantaneous, accurate response to steam demand *when you need it*—not 15 seconds later. War plants need this flexibility of operation and all of them equipped with Hagan Control have it.

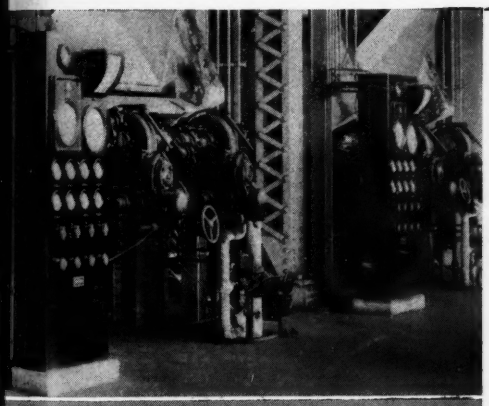
Other factors may vary but Hagan Control is so sensitive to the slightest change in demand, so automatic and independent of human help, so quick in its response, and above all, so dependable, it is one known quantity you can always bank on.

This dependability is only one of the important characteristics of Hagan Control.

Topping even that in importance today is the improvement it makes in steam output. Because, regardless of other means to increase boiler capacity, Hagan Control, by adjusting all auxiliaries for maximum output, will insure the maximum of steam from every pound of fuel.

Why, is no trade secret. It is simply due to exclusive Hagan features of design and operation—the perfection of engineering principles pioneered by the very men responsible for Hagan Control today.

This will be good news to many power plant operators who have been forced through the necessities of war production to ignore measures of economy. While you might make the investment today to pay off in efficiency, there is no question of the dividends you'll get during many years of peace. We would like the opportunity to prove it.



HIGH COMBUSTION EFFICIENCY, even with unskilled operators, is obtained by a Hagan Control system in an industrial power plant. With today's manpower shortage this is a distinct advantage.

HAGAN CONTROL ASSURES

MAXIMUM QUANTITY of steam from any given plant, by introducing fuel and air in correct proportion for utmost efficiency.

MAXIMUM UTILIZATION value, uniform steam pressure and temperature, in accordance with demand.

MAXIMUM OUTPUT from boilers of differing capacities, automatically.

MAXIMUM STEAM for production, by reducing loss of steam in frequent soot-blowing.

MAXIMUM PROTECTION of auxiliary equipment, fans, stokers, etc., by maintenance of uniform operating conditions.

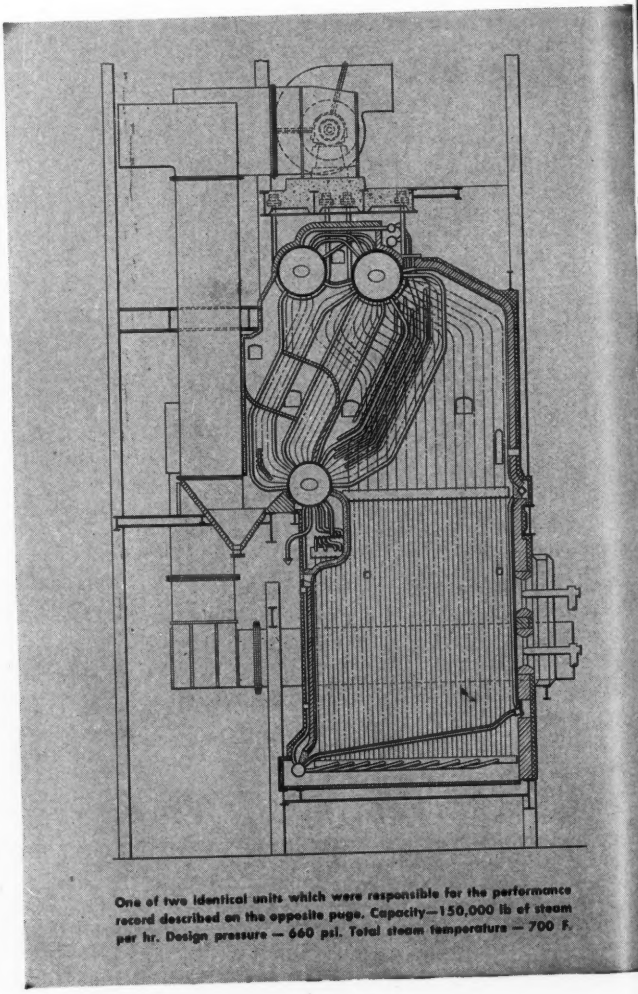
HAGAN
HALL
BUROMIN
CALGON

HAGAN CORPORATION · HAGAN BUILDING · PITTSBURGH, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

5 years... 2 units...



One of two identical units which were responsible for the performance record described on the opposite page. Capacity—150,000 lb of steam per hr. Design pressure — 660 psi. Total steam temperature — 700 F.

98.2% service!

Here's another industrial record that shows what dependable steam generating equipment can accomplish. In a plant of one of the nation's largest chemical companies there are two C-E steam generating units which have been in service for 98.2% of all the available hours in the five year period from 1938 to 1942 inclusive. In that time the two units together produced a total of 12,250,000,000 lb of steam which is 94% of the maximum potential, or the amount that might have been produced if the units operated continuously at maximum capacity for the entire period.

The consistency of this performance is evidenced by the most recent record . . . during our first year of war . . . when the two units responded to the need for maximum steam generation and reliable performance by operating for 98.9% of all the time in the entire year of 1942. In other words, the C-E units were out of service for all purposes, inspections and repairs to both boilers and accessories, for approximately 1% of the total time.

The uniformity with which C-E units in industrial plants throughout the country continue to meet the war time steam load is evidence of the standards of quality which governed their original design and construction.

A-737

COMBUSTION ENGINEERING

200 MADISON AVENUE, NEW YORK, N. Y.

Canadian Associates
COMBUSTION ENGINEERING CORPORATION LIMITED
Montreal Toronto Winnipeg Vancouver

Announcing the R

REPUBLIC
INSTRUMENTS
AND CONTROLS

in one
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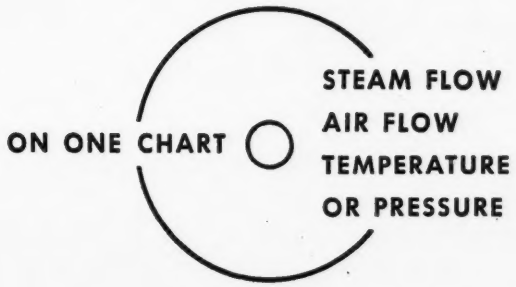
222

Republic Boiler Meter



● The new Republic Boiler Meter provides, in one instrument and on one chart, all the essential information concerning boiler performance regardless of the size or type of boiler, kind of fuel or method of firing.

The meter indicates, records, and integrates steam flow from the boiler and records rate of air flow for combustion. When the correct amount of air for maximum combustion efficiency is being supplied the air flow pen will record coincident with the steam flow pen, regardless of the load being carried by the boiler.

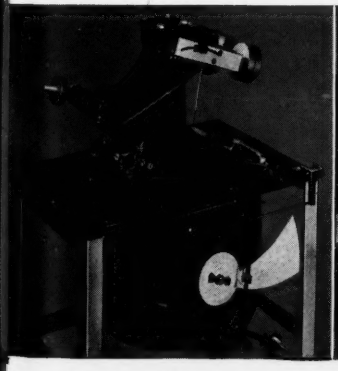
A third pen recording flue gas temperature (or steam pressure) can be added thereby providing the operator with complete information, on one 12-inch chart, relative to the performance of the boiler at any given time.

The Republic Boiler Meter is primarily a boiler operating guide. The two records, steam flow in red and relative air flow in blue, tell the operator instantly whether correct combustion and furnace conditions exist, thereby enabling him to correct faulty conditions when they occur.

The Republic Boiler Meter consists of a standard Republic electric steam flow recorder and integrator and an oil sealed, bell type air flow element.

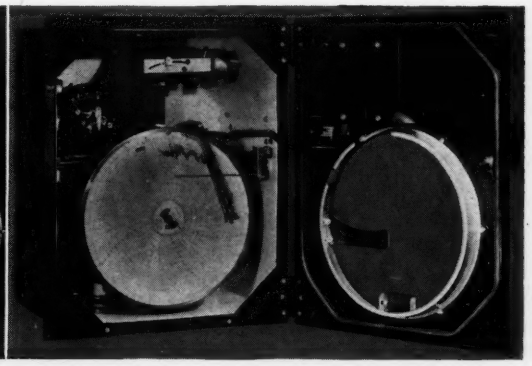
The air flow element consists of an oil sealed bell in a sealed chamber. The motion of the bell is transmitted through a diaphragm seal. This arrangement permits the use of a single bell—the high pressure being applied to the top of the bell and the low pressure under the bell. This arrangement also excludes air and dirt from the oil. The motion of the bell is transmitted to a cam system which extracts the square root, or when adjusted for a particular installation, compensates for chimney action and variable excess air requirements. The air flow pen is attached to the cam system with an adjustable linkage which permits changing the steam flow air flow ratio as conditions may require.

The entire operating mechanism is housed in a rugged steel case and can be easily removed as a single unit by merely loosening two anchor bolts and disconnecting the two air connections. The meter may be either wall mounted or flush mounted on a steel panel. *Write for Bulletin No. 420.*



Meter assembled as one unit on rack ready for calibration.

Meter assembly can be easily removed from the case.



Meter with door open showing accessibility of all adjustments and working parts.

Republic Flow Meters Co.

2224 Diversey Parkway • Chicago 47, Illinois

Garlock

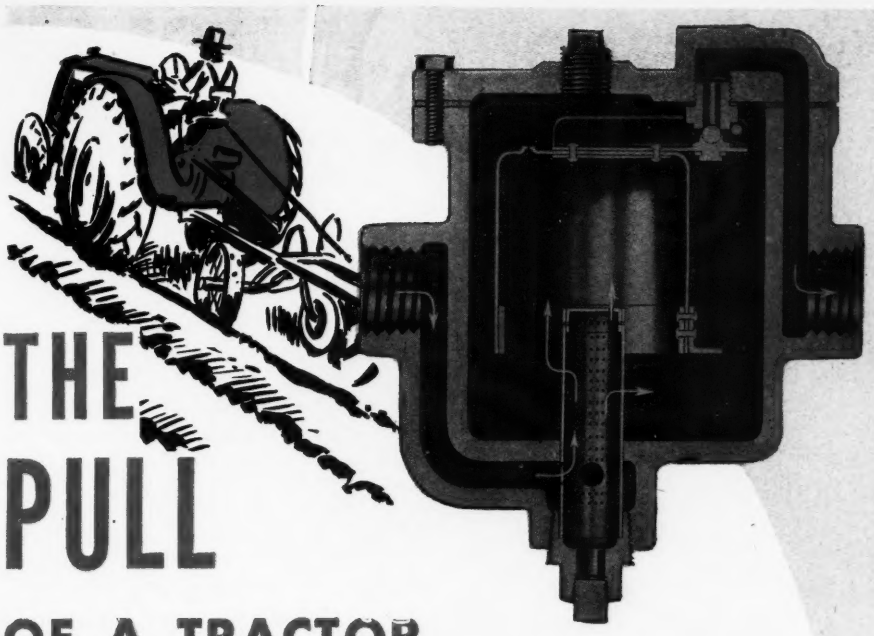
if we do our part back home!

Our Navy will give 'em the works, if we'll give 'em all we've got back here in America. That means working a *full* week *every* week . . . it means no unnecessary driving . . . it means conserving materials . . . and it means that we must all buy War Bonds regularly. Let's all do our part today and every day until the war is won!

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Manufacturers of GARLOCK Packings, Gaskets and KLOZURE Oil Seals

In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.



THE PULL OF A TRACTOR

with

The Sarco BUCKET STEAM TRAP

for

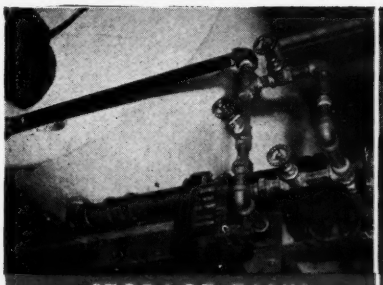
STEAM MAINS
PROCESS STEAM LINES
KETTLES AND PANS
TANKS
DRYERS
PRESSES
EVAPORATORS

For sheer capacity, the Sarco Bucket Trap can outhaul any other type in terms of condensate delivered. It will take the toughest load of a laundry or platen press in its stride. On busy supply lines to engines, turbines, pumps, and refinery equipment, it removes all condensation as fast as formed, assuring dry steam to the equipment.

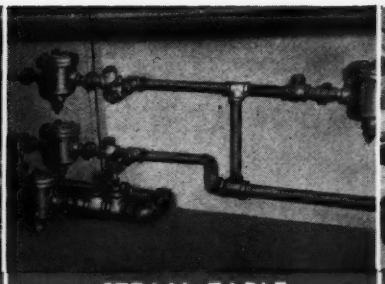
Five outstanding advantages:

1. Straight-through connection saves piping.
2. Cleaned without disconnecting.
3. Strainer is included inside the trap — saving the cost of separate strainer installation.
4. Can be equipped with thermostatic air by-pass.
5. Made in three standard ranges up to 250 lbs., and in special types of forged steel up to 900 lbs.

Ask for Catalog No. 350.



STORAGE TANK



STEAM TABLE

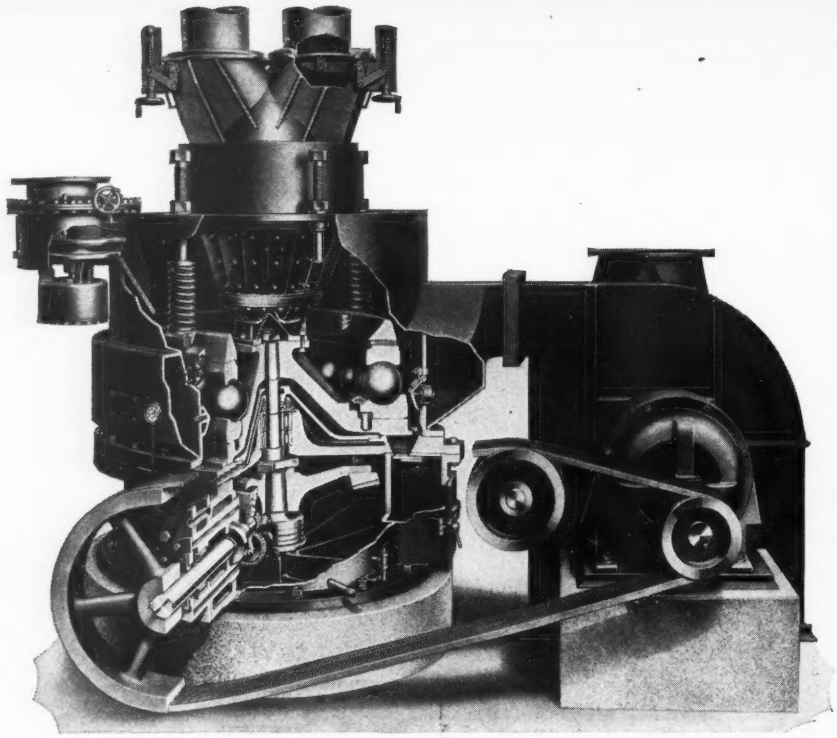
PLATEN PRESS

SARCO COMPANY, INC.
475 FIFTH AVENUE
NEW YORK 17, N. Y.
REPRESENTED IN PRINCIPAL CITIES

SARCO Saves Steam

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO

For OIL during



B&W Type E Pulverizer for direct-firing pulverized-coal systems. Available in 15 sizes and in capacities from 3100 lb. per hr. to 25,400 lb. per hr., based on coal of 57 grindability pulverized to pass 65 per cent through the 200-mesh screen.

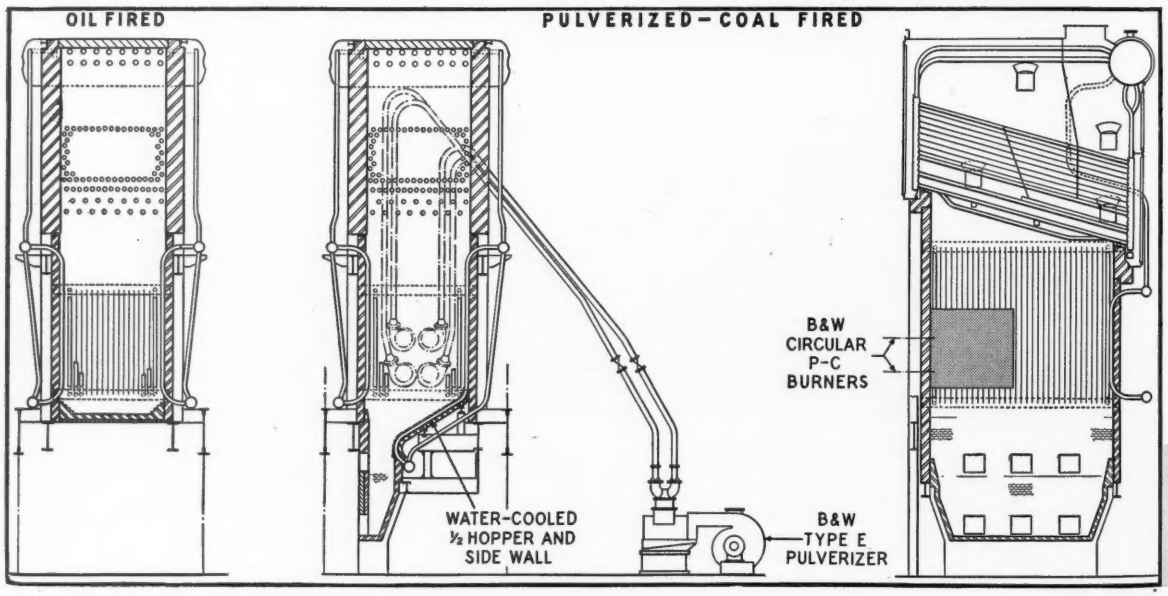
TYPICAL CONVERSIONS

Furnaces converted from oil firing to pulverized-coal firing vary considerably in the changes necessary. Cases in which a reduction in boiler capacity is permissible and increased furnace volume and water cooling are unnecessary, require minimum critical material.

The typical case shown below already had considerable water cooling. By converting straight water-cooled side walls to half hoppers along the length of the two boilers to provide ash pits, it was possible to maintain the minimum permissible capacity of 50,000 lb. steam per hr. Two Type E Pulverizers were readily applied to serve B&W Circular Burners installed in the refractory front walls.

Other cases in which no reduction in boiler capacity is permissible may require more extensive alterations, particularly if additional furnace volume is required and modifications of, or additions to, existing water cooling are necessary.

B&W Integral-Furnace Boilers, being designed for multi-fuel firing, have been readily converted merely by the installation of the coal handling and pulverizing equipment, no other changes being necessary.



Conservation and Economy—Fuel Emergency and Afterward PULVERIZED-COAL FIRING

If you are burning oil in your boiler furnaces and are planning to convert to coal firing, either through necessity or for economic reasons, now is not too soon to consider the fuel-burning system to employ—not merely as a temporary expedient in the case of forced conversion, or as a stand-by, but for permanent installation. Such a conversion would not only be in the desirable direction of helping save oil for the future and for highly specialized uses in the interest of the national welfare but also would reduce your fuel cost in the face of advanced oil price due to shortage.

The B&W Direct-Firing Pulverized-Coal System with Type E Pulverizer is a profitable investment for such conversion. It is a fully co-ordinated system, from raw-coal bin to burners. It affords the most flexible and efficient means of burning coals of a wide variety, permitting the utilization of those that are most readily obtainable. This system reliably handles coal of a wide range of grindability and surface moisture content, and maintains capacity and fineness throughout the life of the pulverizer grinding-elements. Furthermore, this system is easily and safely operated, with pulverizer output controlled at one point—the primary-air damper—and the coal feed is automatically varied according to air flow, by the feeder controller.

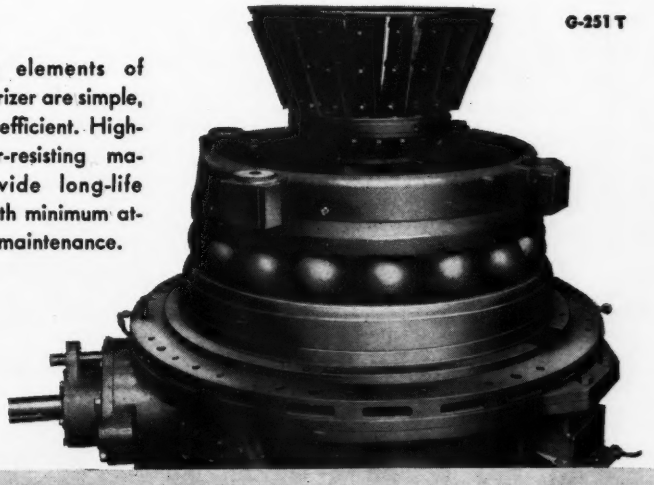
The Type E Pulverizer is a sturdy unit with ball-bearing grinding element of materials that give the utmost in service, considering the nature of the materials handled.

And B&W experience with pulverized-coal firing, which dates back to its early use for firing cement kilns, further suggests investigation of the B&W Direct-Firing System for your boilers.

Bulletin G-30A sent on request

Grinding elements of Type E Pulverizer are simple, sturdy, and efficient. High-grade wear-resisting materials provide long-life operation with minimum attention and maintenance.

G-251 T



THE BABCOCK & WILCOX COMPANY
85 LIBERTY ST., NEW YORK 6, N. Y.

BABCOCK & WILCOX

FLY ASH TROUBLES

Switched High Pressure Design to

TAYLOR STOKERS

THIS COMPANY, manufacturing high grade paper, had previous experience with stokers not utilizing the underfeed principle. They had a fly ash problem. However, impressed by Taylor Underfeed Stoker's record for freedom from smoke and fly ash, they unhesitatingly designed Taylor Stokers into their new high-pressure unit. Since installation it has measured up to all expectations.

The unit, which was installed last year, includes a Taylor Continuous Ash Discharge Stoker to generate 50,000 lbs. of steam per hour at 425 lbs. gauge, 650°F. total steam temperature.

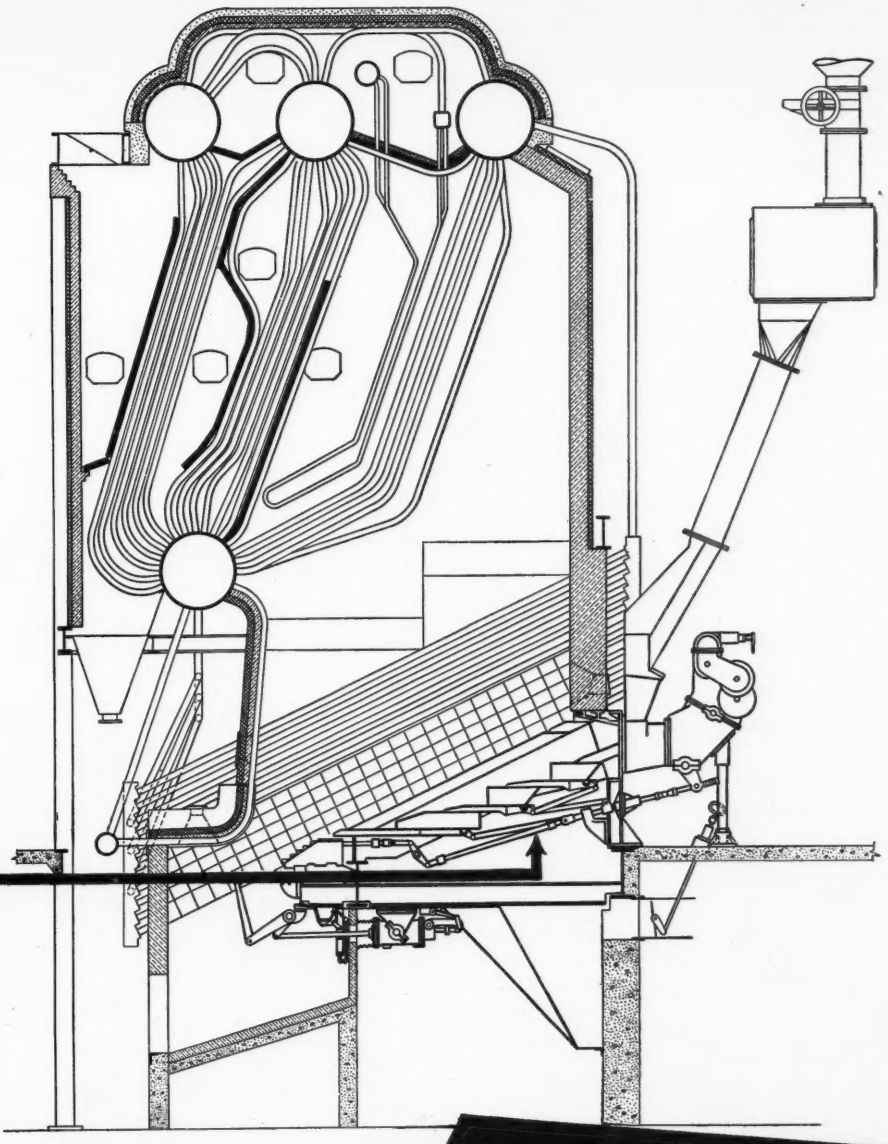
This Taylor Stoker installation is burning either Indiana or West Virginia coals, both of which are available, with equal ease and freedom from smoke and fly ash nuisance.

JUDGE THE SELECTION OF FUEL FIRING EQUIPMENT BY THESE TWELVE POINTS

1. **RELIABILITY**—the ability to operate with minimum outage and minimum standby equipment.
2. **CAPACITY**—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.
3. **MAINTENANCE**—the ability to operate continuously with minimum repair costs.
4. **FLEXIBILITY**—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.
5. **EFFICIENCY**—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.
6. **OPERATION**—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.
7. **ADAPTABILITY**—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.
8. **FUEL FLEXIBILITY**—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.
9. **REFUSE DISPOSAL**—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.
10. **STACK DISCHARGE**—the practical elimination of "smoke nuisance" without special equipment.
11. **SPACE REQUIREMENTS**—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.
12. **OBSOLESCENCE** — the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

AMERICAN ENGINEERING

PHILADELPHIA • PENNSYLVANIA



A-E-CO TAYLOR STOKERS
LO-HED HOISTS
HELE-SHAW FLUID POWER
MARINE DECK AUXILIARIES

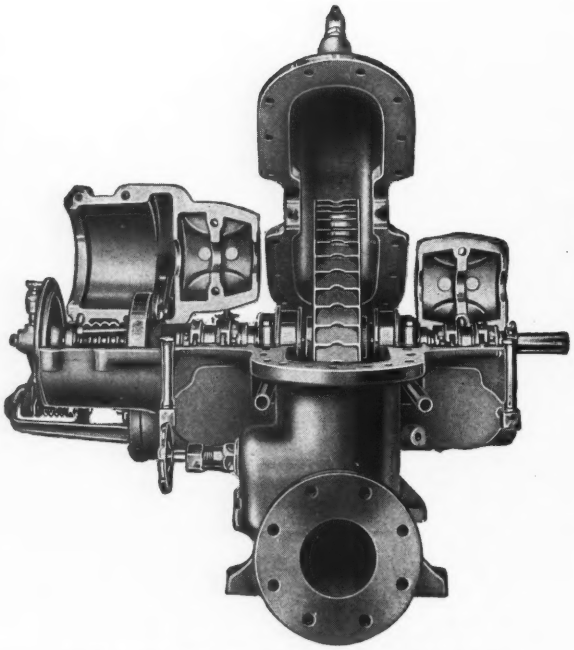
A-E-CO
TAYLOR STOKER

COMPANY

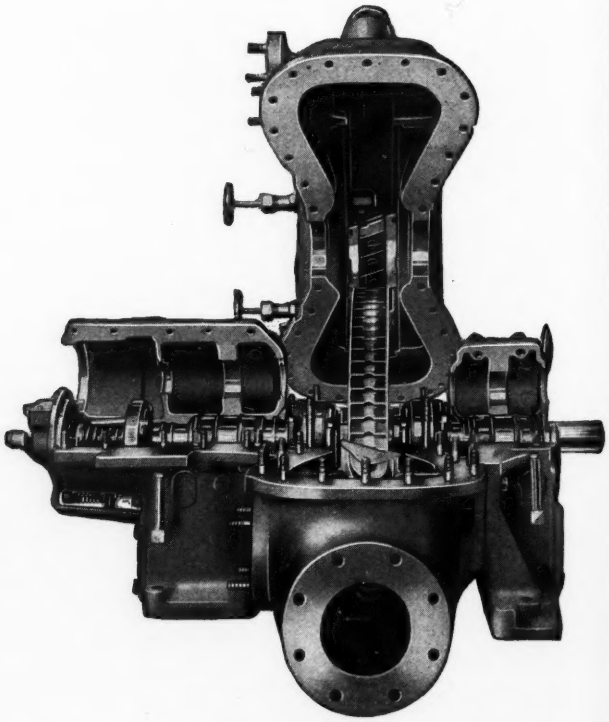
AE CO 75th ANNIVERSARY

The TERRY

OFFERS COMPLETE COVERAGE OF MECHANICAL DRIVE TURBINES



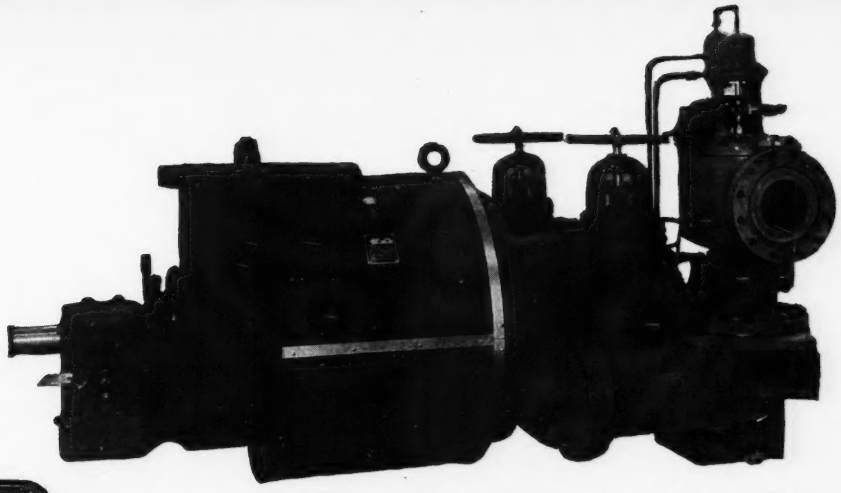
Terry Solid Wheel Turbine with Top of Casing Raised. Note the ruggedness and the ease with which the interior parts can be inspected — one of the country's leading oil companies employs 308 of these units for driving various types of refinery pumps. Full details are available in Bulletin S-116.



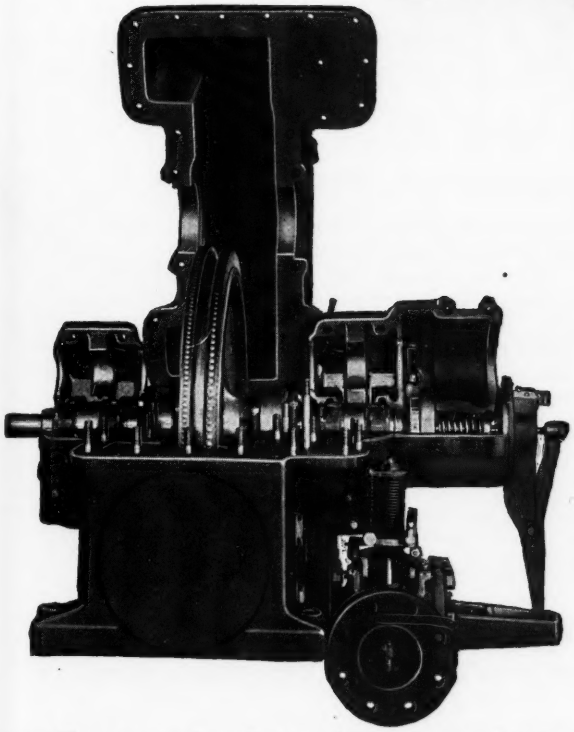
Twelve Terry Solid Wheel Turbines, similar to the above unit, drive auxiliaries in the power house of an east coast refiner. They operate with steam at 625 lbs. pressure — 700° Total Temperature. Eight of the machines exhaust against 125 lb. back pressure. The first of these units was purchased in 1931. It proved entirely satisfactory so that as the plant was enlarged, duplicate Terry's were added. Bulletin S-99.

THE TERRY STEAM TURBINE CO.

TURBINE



1200 Horsepower Terry Multi-stage Turbine. Units of this type are employed extensively for driving large refinery pumps. The units may be designed for non-condensing, condensing, mixed pressure, or bleeder operation. They may be equipped with constant speed or variable speed governors, remote speed controls or with special governors to meet unusual requirements. Ask for Bulletin SR-114.



Axial Flow Impulse Terry Turbine — one of a complete line — built with either two or three rows of blading. These units, like all Terry turbines, are the result of over 45 years of successful experience in the manufacture of turbine drives exclusively. Completely described in Bulletin S-107.

T-1151

TERRY SQUARE - HARTFORD, CONN.

Maintenance Saving

72.5%
MAINTENANCE SAVING
Of reports turned in over the past 13 years dealing with maintenance savings effected with Armstrong Traps, those that give figures show savings averaging 72.5%.

. . . a BIG HELP in the manpower emergency

SINCE most trap installations are made chiefly to secure maximum heating efficiency and minimum fuel consumption, the manpower necessary to maintain the system in top condition is not often considered. But in the present manpower emergency, this factor assumes important proportions.

Simple, positive operating Armstrong Traps, with corrosion proof mechanism and self-scrubbing action, minimize trap and steam line maintenance—eliminating an irritating nuisance and freeing busy engineers for more productive work.

Two examples:

. . . 50 Armstrong traps, including 32 on a Proctor & Schwartz dryer, reduced maintenance on steam lines from 20 man days per month to only one day per month!

. . . On an installation of 300 Armstrong Traps in a photo supply plant, trap maintenance was reduced as much as 50% over that required for previous equipment.

Armstrong Traps repay their cost in other ways too; in fuel saving, heating time saving, and savings in steam generating requirements. An Armstrong Trap representative will be glad to give you details, and help you on trapping problems.

Ask for the Armstrong Trap Book, giving facts and figures on all trapping problems.

ARMSTRONG MACHINE WORKS
810 Maple Street • Three Rivers, Michigan

ARMSTRONG INVERTED BUCKET STEAM TRAP

Armstrong STEAM TRAPS
HUMIDIFIERS • PURGERS

The rout of the unstable hydrocarbons

(Important to turbine oil users)

It would be a happy day for oil men, if petroleum's hydrogen and carbon atoms, once having united, would remain inactive. But some of these hydrocarbons are unstable -- they're on the hunt for oxygen. When they get it, they're bad actors. In turbine oil, they cause deposits, sludge, acidity, poor demulsibility, etc. Some of them tend to form asphaltenes, others to form acids. Refining can remove all the asphaltene-forming type, but at the cost of also removing valuable anti-oxidants. Therefore, some of these trouble makers are left in conventional turbine oils. The asphaltene-formers are all removed from Nonpareil, but the anti-oxidants are restored by adding a patented inhibitor. The acid-forming hydrocarbons can't all be removed by the refining process, but the addition of this inhibitor renders them harmless. As a result, we are able to guarantee that Nonpareil's acidity (as expressed by neutralization number) will never exceed 0.15. In service, the number is more likely to be about 0.05, without batch treatment, resting, or replacement, as has been proved in hundreds of turbines. Thus, by beating the two basic types of oxidation troubles, Nonpareil Turbine Oil is able to and does stay clean -- retains its "new-oil" condition -- permanently.

Use it, and you'll never again need to clean your turbines. A Standard Lubrication Engineer will gladly furnish details, service records, and further proof.

Phone, or write your nearest Standard Oil Company (Indiana) office, or 910 South Michigan Avenue, Chicago, Illinois. In Nebraska, address Standard Oil Company of Nebraska at Omaha.

NONPAREIL TURBINE OIL

Oil Is Ammunition . . . Use It Wisely

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

★ **LUBRICATION ENGINEERING**

LUBRICATION ENGINEERING • • • LUBRICATION ENGINEERING • • • LUBRICATION ENGINEERING • • • LUBRICATION ENGINEERING

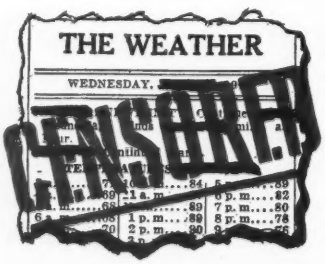
Lubrication *News* letter

Practical suggestions from the field on how Lubrication Engineering and lubricants are being used by midwest operators to lick tough wartime jobs.

SEPTEMBER, 1943

Quieter valves . . . no scoring . . . with 40% less cylinder oil. Rough running valves and scoring of the low pressure cylinder in a cross compound Corliss engine became a serious problem when it interrupted power production for war work in a central states plant. Even large quantities of an expensive cylinder oil fed into the high pressure steam line failed to give adequate lubrication.

Then a Standard Lubrication Engineer's suggestion was tried. A small lead was installed from the high pressure steam line to a Superla Atomizer in which steam condensate and oil were mixed and then fed to the low pressure cylinder. Separate oils were used for the high and low pressure cylinder lubrication. This, plus the more complete atomization of the oil, ended the trouble. After six months' operation all parts show excellent lubrication. Consumption has dropped 40%.



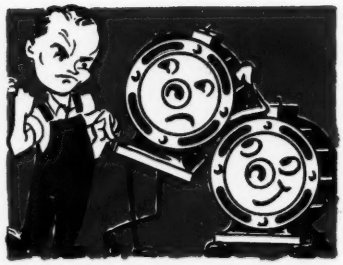
You don't need weather reports with Stanoil. Quick changes in temperature are no problem when you have Stanoil in motors, speed reducers, and other equipment exposed to the weather. Stanoil's high viscosity index —its ability to resist changes in fluidity over a wide range of temperatures— plus its low pour test, assure a free flowing oil at low temperatures and adequate lubrication at normal operating temperatures.

A Wyoming operator reports that speed reducer operation in severe cold weather had always been troublesome until Stanoil was used last winter. Result, no starting trouble, plus a substantial power saving.

What are your problems in maintenance and lubrication?

The few examples cited here are typical of the jobs Standard Lubrication Engineers are doing daily for operators who have asked for help. Take the time to explain your problems to one of these Engineers. He may have a number of suggestions that will help you save much needed manpower, materials, and scarce equipment. Call any local Standard Oil Company (Indiana) office, or write 910 S. Michigan Avenue, Chicago 5, Ill., for the Engineer nearest you. In Nebraska, write Standard Oil Company of Nebraska at Omaha 2.

Saves four out of five gallons of oil with Stanodrip diet. In an 8-day test, one gallon of Stanodrip was needed in place of five gallons of regular oils formerly used to lubricate a wire-bending machine in an Illinois plant. Add to that the time this saved in lubricating the machine and in cleaning excess oil from the machine and floor, and it is easy to see why this manufacturer started looking for more spots where Stanodrip could be used. Why not put some of the oil-hungry bearings in your plant on a diet of Stanodrip?



Better lubrication puts idle stand-by motor to work. Bearings on the motor driving a ventilating fan in a Michigan mine failed often enough to require keeping a stand-by motor on hand to take over this important job. But when spare motors became scarce, and the extra bearing maintenance and replacement a problem, special effort was made to eliminate the trouble. That's when a Standard Lubrication Engineer was asked for his opinion. His analysis led him to recommend Superla Grease No. 2X. That was two years ago. No bearings have failed on this motor since then. The "stand-by" now fills an important job elsewhere.

6 months in hydraulic system is "only the beginning" for Stanoil. Here's a practical demonstration of oil stability you hear so much about. Three bomb spinners in a Wisconsin plant had operated eighteen hours a day for six months. Long enough, ordinarily, to require changing oil in the hydraulic system. But when the oil was examined there was no sign of discoloration or deposits. The oil was like new and it was left in the units. It was Stanoil. A Standard Lubrication Engineer had "sold" the idea of using this high stability oil to eliminate deposits and replacements. It is doing all he promised and more.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

ELECTROPLATING
With a Brush

A Most Efficient Low Cost Process

For applying permanent deposits or plating of pure silver, cadmium, zinc, copper, nickel or tin;—

Bonds to base metal better than by any other known process—and in less time.

No Dismantling of Equipment

Portable Electric Brush Plating can be used on standing installations, right on the job, thus saving untold man hours in "touch-up" of damaged or defective plating as well as in protective work, in every business and industry, directly or indirectly concerned with the war effort.

Prevents oxidation of critical metals, improves conductivity and so reduces heating of electrical contacts with its loss of power.

This modern process is in daily use in over a thousand industrial and power companies. It is the only process of its kind approved and used by both the U. S. Navy and Air Corps.

NEW LOW group price for complete outfit ready for use as illustrated, only $189.50, f.o.b. Chicago. Brushes are made of *Nylon* bristles which last indefinitely and are acid resisting. The power unit, with fittings and supplies pictured, is all you need for this modern electroplating process.

Arrow points to new *large type* (3½x5") Plating Applicator, especially designed for silver plating bus bars, switch blades, etc., with an even more rapid deposit of metal. Only a few seconds required to plate an average area. This type of applicator also available for deposition of cadmium and zinc.

Portable Brush Plating — Low in initial cost — Low in production cost

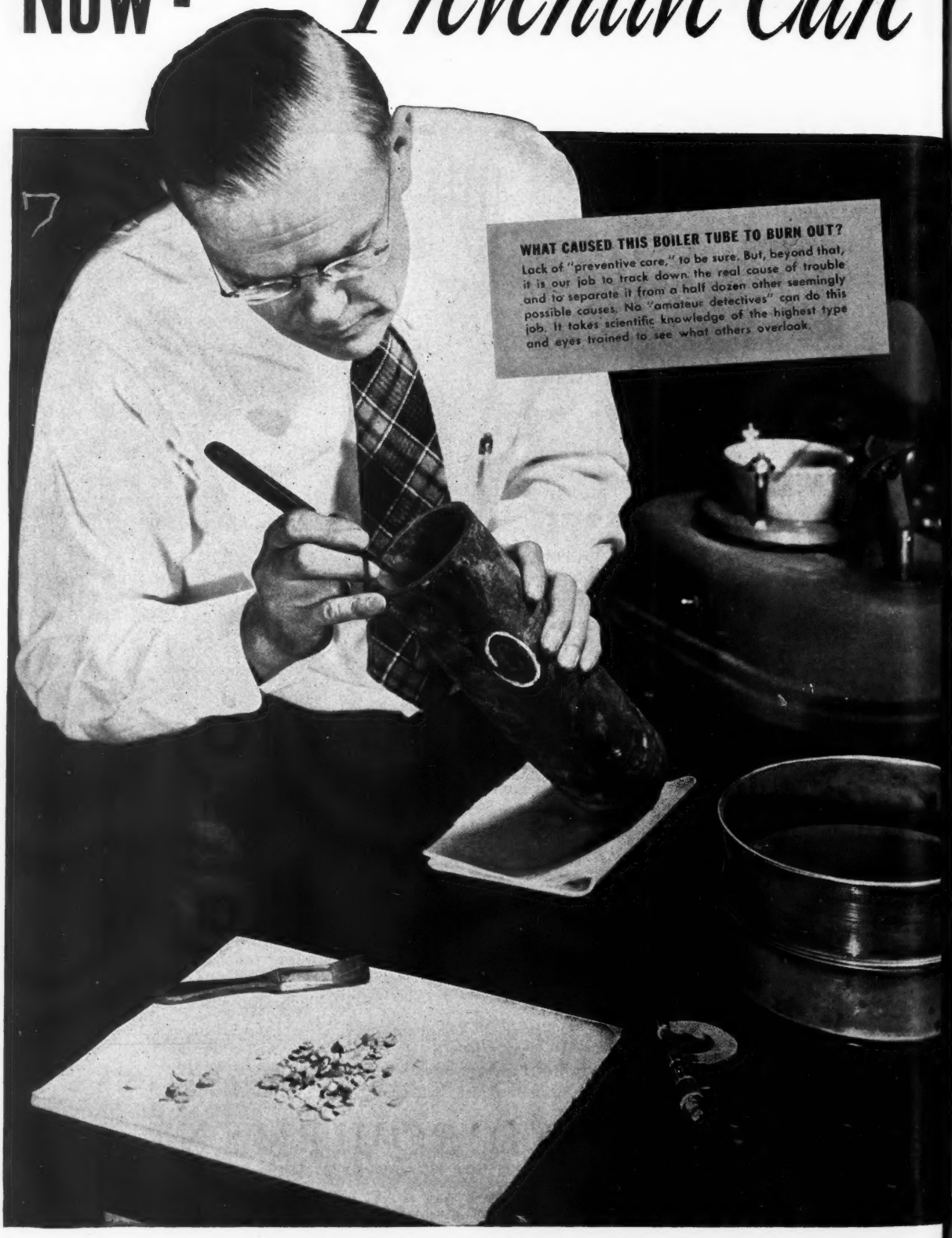
Order your equipment today, or send for your copy of "All Out For Metal Conservation" and engineering bulletins.

CONSOLIDATED EQUIPMENT, INC.

Service to Utilities, Industry and Railroads

4623 WEST 20TH STREET **CHICAGO 50, ILLINOIS**

Now - "Preventive Care"


WHAT CAUSED THIS BOILER TUBE TO BURN OUT?
Lack of "preventive care," to be sure. But, beyond that, it is our job to track down the real cause of trouble and to separate it from a half dozen other seemingly possible causes. No "amateur detectives" can do this job. It takes scientific knowledge of the highest type and eyes trained to see what others overlook.

is a wartime necessity

Doing "too little, too late" to prevent boiler outages is a poor way to win battles on the production front

IT is probable that the boilers served by every power plant operator who reads this are wholly or in part engaged in making steam for critical war production.

That makes "preventive care" a positive *must*. Nothing else will give such assurance of uninterrupted steam output.

Some operators think they can manage this job alone. Others have partial help. All credit to those who are successful.

But there is something significant in the fact that hundreds of the foremost and best equipped and manned plants in the country wouldn't consider for a moment being without continuous specialized technical assistance. Time after time they've had occasion to see how well it pays.

Hall Laboratories chemists have blazed the trail for "preventive care." The pioneering they have done and are doing in boiler water conditioning forms the foundation for the service we offer today.

Hall preventive care is as broad as its need. Every problem you face in keeping your boilers in prime working condition is directly *shared* by the Hall Field Engineer who works with you. It is his responsibility, and that of Hall Laboratories behind him, to see that everything possible is done to help prevent troubles caused by water.

You have never faced a time when there was such a patriotic necessity to conserve every working part of your equipment and keep it in top producing condition. May we explain how we could help you to do it?

HALL LABORATORIES, INC. · HAGAN BUILDING · PITTSBURGH, PA.

A subsidiary of Hagan Corporation

Hall Service in a Nutshell

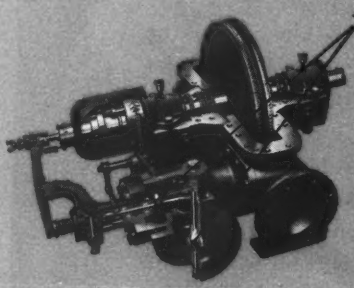
At your immediate disposal are placed the technical knowledge and facilities of the pioneering leaders in scientific boiler water conditioning. In addition, with your full cooperation, Hall Service:

1. Minimizes boiler outages caused by water.
2. Helps maintain highest efficiency.
3. Establishes non-embrittling water.
4. Minimizes carryover.
5. Prevents corrosion in boilers and associated equipment.
6. Prevents deposition in water lines and cooling systems.

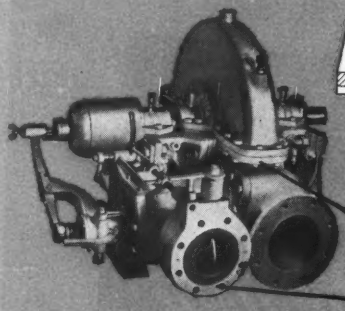
HALL SYSTEM *of Boiler Water Conditioning*

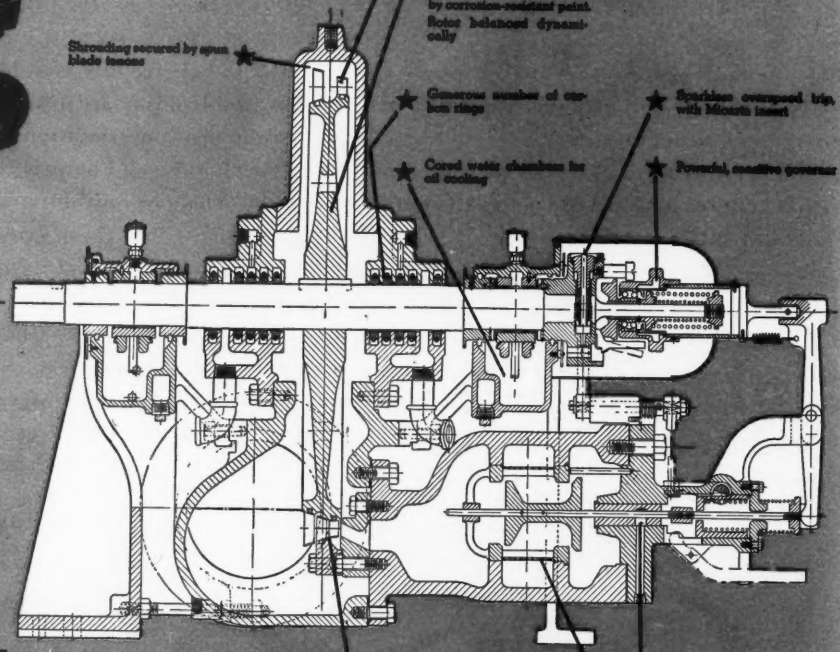
HAGAN
HALL
BUROMIN
CALGON

FOR intermittent OR . . .



SINGLE-STAGE—5 to 1000 hp. 1000-5000 RPM.—Type C turbine, cutaway to show Dual Protection mechanism. For steam conditions through 600 lbs. ga. 750° F inlet, 50 lbs. ga exhaust.




DUAL PROTECTION
Overspeeding trips both valves at once
Chrome-alloy blades
One piece disc, shrunk and keyed onto shaft. Protected by corrosion-resistant paint. Rotor balanced dynamically
Shrouding secured by spun blade tenons
Generous number of carbon rings
Sparkless overspeed trip, with Micarta insert
Cored water chambers for oil cooling
Powerful, sensitive governor
Steam path contoured for efficiency
No soft packing on inlet valve stem
Ground horizontal joint—no gasket
Heavy-duty hand valve with bolted bonnet
Steam strainer about inlet valve
Heavy construction

Westinghouse

PLANTS IN 25 CITIES OFFICES EVERYWHERE

continuous duty

There's More for Your Money in Turbines from Steam Headquarters

Broadly speaking, mechanical drive turbines in a refinery fall into two classes, according to their assignments. Some are called upon for the 24-hour-a-day steady pull of a continuous duty drive . . . others are idle much of the time.

ALL TYPES OF TURBINES are included in the Westinghouse line. There are low-cost Type C single-stage units, 5 through 1000 hp, and types C-225 and C-325—larger multi-stage turbines that combine low first cost with added steam economy, for capacities through 1500 hp . . . Type CH heavy-duty, single-stage, built for high-pressure, high-temperature operation from 50 to 2000 hp . . . and Type M multi-stage turbines, up to 5000 hp, for high-efficiency service.

SIMPLIFY TURBINE SELECTION by coming to Steam Headquarters. Whatever the job . . . continuous or intermittent duty . . . Westinghouse Turbines operate safely, economically, reliably.

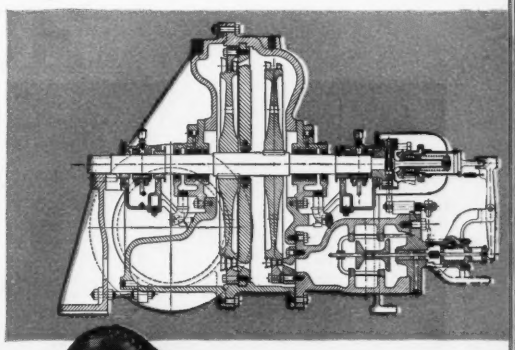
SAFE—Overspeeding is prevented. On Types C and CH, Dual Protection trips shut *both* the governor valve and the butterfly valve *simultaneously,* in event of overspeed.

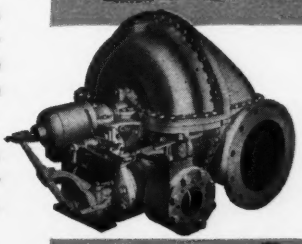
ECONOMICAL—Blading proportions are the result of extensive research. Blade pitch is uniform. Blade shrouding is made conical to approximate the steam expansion characteristic. Nozzle dimensions are accurate. All this adds up to maximum steam economy.

RELIABLE—Fully protected against corrosion and erosion. Blades and shrouds are chrome-alloy. No soft packing is used on the governor valve stem.

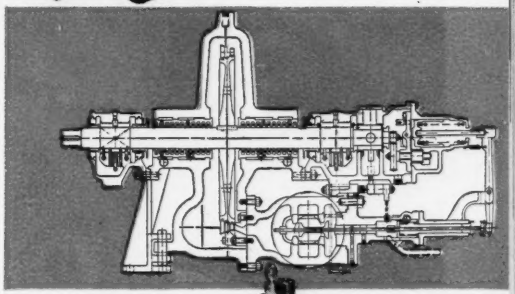
MAINTENANCE HELP is as convenient as your telephone. A national organization of steam experts is ready at all times to help you keep your steam equipment up to par.

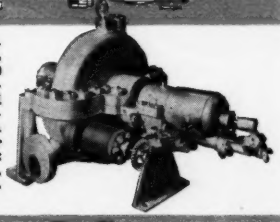
SEND FOR THE BOOK YOU WANT—
B-2230-A on Type C Turbines. B-2175 on Type M.



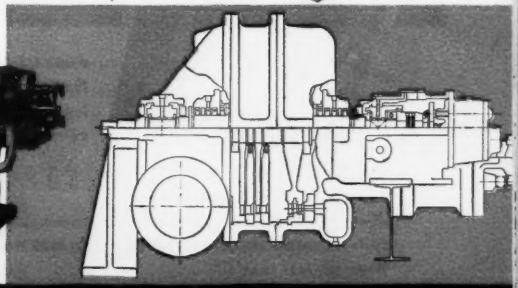


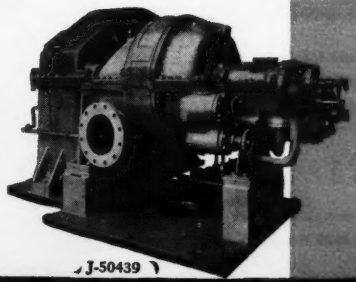
TYPE C—50 to 1500 hp, 1000-4500 rpm—Type C-225, "big brother" of Type C's, combines low first cost with higher efficiency. For steam conditions: through 600 lbs. ga., 750° F. inlet, 50 lbs. ga. exhaust.





HEAVY-DUTY SINGLE-STAGE—50 to 2000 hp, 1000-4500 rpm—Type CH turbines for high initial pressures and temperatures, and high back pressures. For steam conditions: through 1500 lbs. ga., 950° F. inlet, 300 lbs. ga. exhaust.





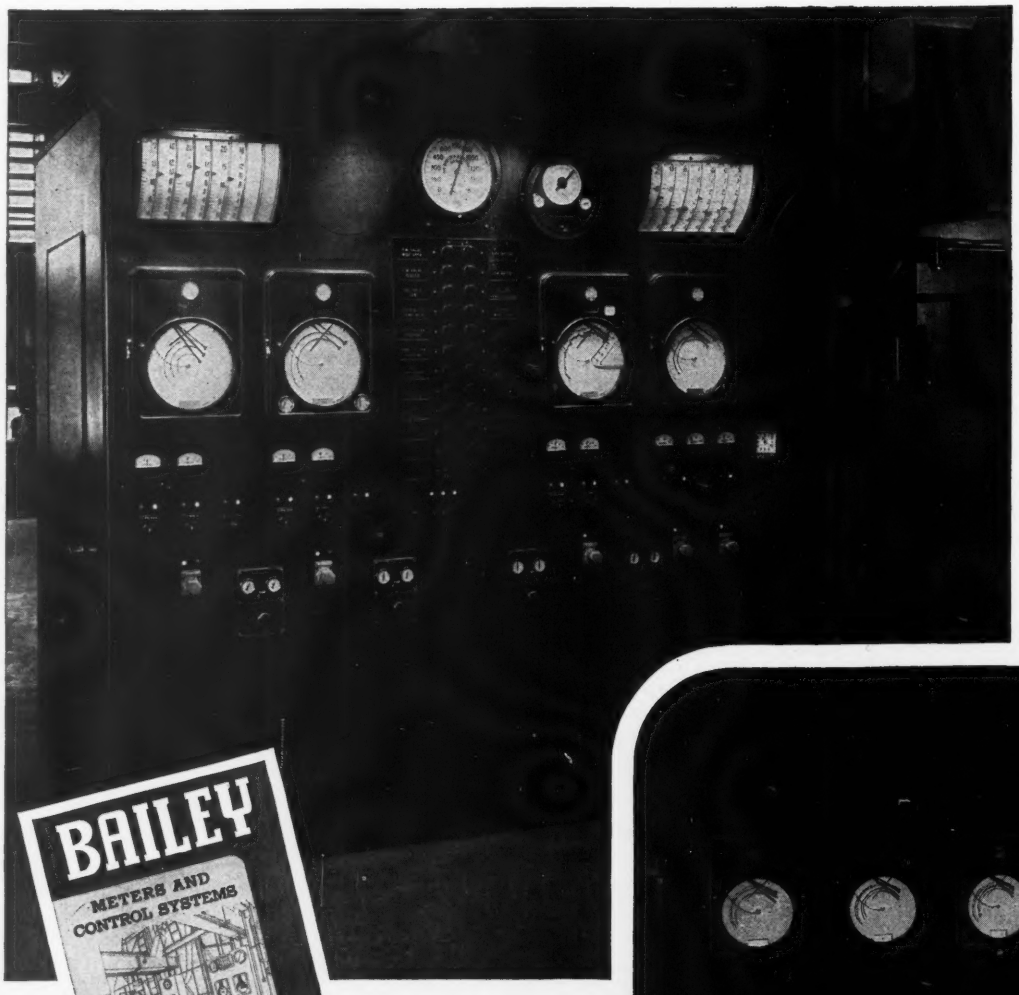
MULTI-STAGE—Up to 5000 hp, 1000—5500 rpm—Type M turbines for high-efficiency drive. Condensing, non-condensing and extraction types. For steam conditions: through 600 lbs. ga., 825° F. inlet, 200 lbs. ga. exhaust.

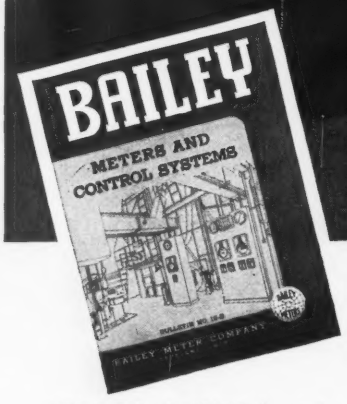
J-50439

STEAM HEADQUARTERS

WESTINGHOUSE

A Service FOR BETTER P



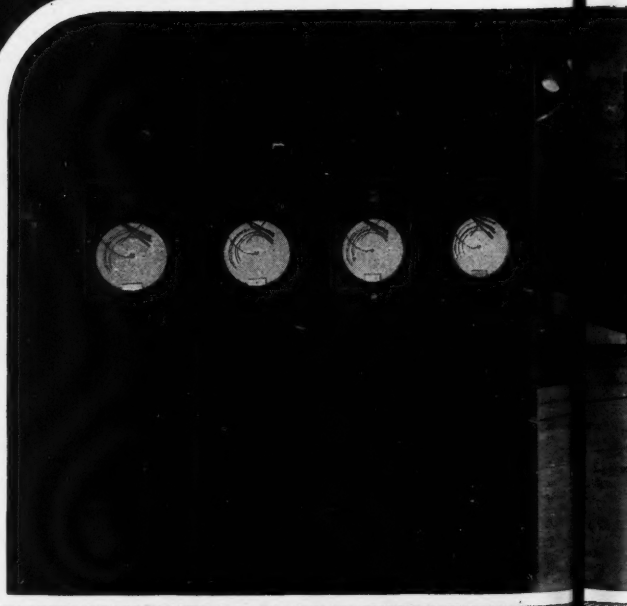


This Bulletin, No. 15-B tells how and where Bailey Meters and Control Systems serve the steam plant. Write for your copy.

Panel for Bailey Combustion and Feed Water Control Systems serving a 450,000 lb. per hr. capacity pulverized coal-fired boiler.

●

Heat Balance and Feed Water Pump Control Panels for the same unit.



BAILEY METERS

BAILEY METER CONTROL

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEA

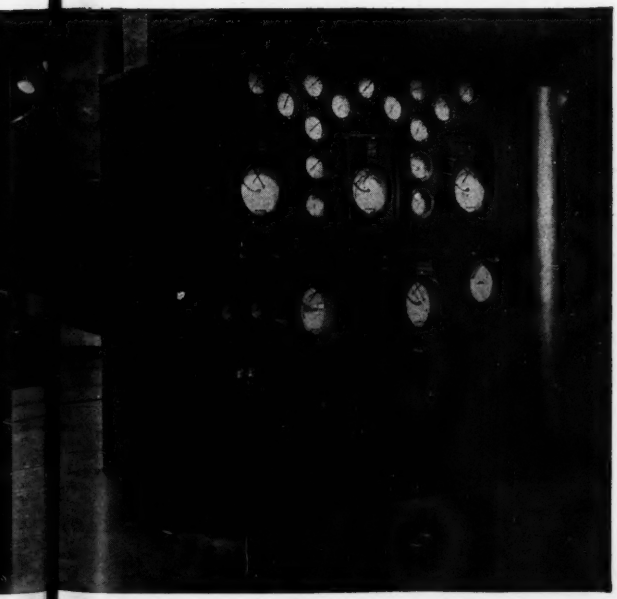
POWER PLANT PERFORMANCE

★ Instead of offering simply meters and controllers, Bailey Meter Company makes available a service which helps power engineers to improve plant performance from the standpoint of:

1. Continuity of Operation
2. Steaming Capacity
3. Fuel Economy
4. Conservation of Man Power
5. Safety

This engineering service starts with a careful consideration of the improvements which may be effected in the generation and utilization of steam and in the control of industrial processes. It continues with the application, design, construction, calibration, installation and adjustment of equipment necessary to secure the desired improvements.

Combustion control, for instance may be supplied as a remote manual system, a partial automatic system, or as a complete automatic system. In any event, the equipment furnished is tailored to the characteristics of the steam generating unit.



Although the basic component parts of Bailey Meters and Control Systems are standardized and produced in quantity to keep the selling price as low as possible, each meter or system is engineered, adjusted and calibrated to satisfy conditions as they exist in the plant where it is to serve.

When field tests must be run to completely adjust equipment to operating conditions, they are conducted by experienced Bailey Field Engineers who are permanently located in the principal industrial centers of the United States and Canada. Final adjustment of the Bailey Boiler Meter is done in this manner. A combustion test is conducted on the boiler to determine the lowest percentage of excess air under which it can be economically operated. With the aid of the boiler meter, which has been installed but not yet finally adjusted, and an orsat flue gas analyzer, the Bailey Engineer determines this lowest economical value. It is determined with respect to 1—CO losses, 2—unburned fuel losses, 3—smoke, 4—refractory deterioration due to excessive furnace temperature.

This value of excess air for which the Bailey Boiler Meter is adjusted may not represent the highest combustion efficiency possible, but it does represent the highest combustion efficiency consistent with economy, reliability and maximum capacity, which is after all the final result desired in boiler plant operation.

For an outline of the many ways in which Bailey Meters and Control Systems serve the modern steam plant, ask for a copy of Bulletin No. 15-B. G-15

BAILEY METER COMPANY
1040 IVANHOE ROAD • CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada

• The Complete Combustion Control System

HEAD CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

Cities Service Announces

A NEW ENGINEERING SERVICE FOR DIESEL OPERATORS

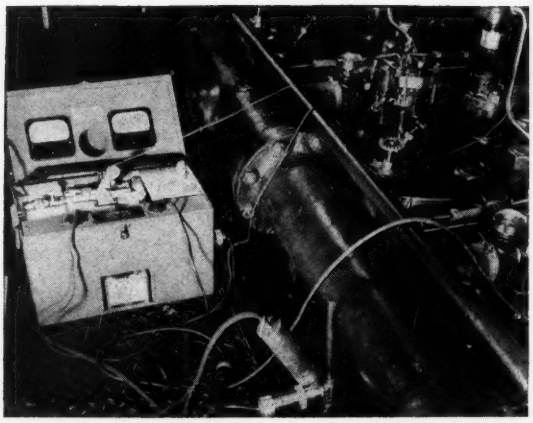
CITIES SERVICE **DIESEL HEAT PROVER** TEST SHOWS OPERATORS OF A. C. DIESEL GENERATORS THESE VITAL POINTS

1. INDIVIDUAL CYLINDER H. P. OUTPUT.
2. INDIVIDUAL CYLINDER COMPRESSION.
3. INDIVIDUAL CYLINDER PEAK PRESSURES.
4. FUEL INJECTION TIMING.
5. MECHANICAL CONDITION OF PISTON AND RINGS.
6. EXACT FUEL ECONOMY.

To help Diesel operators obtain the greatest possible production at the lowest possible operating cost—Cities Service introduces a scientific new "HEAT PROVER" engineering service.

Through this new "HEAT PROVER" service it is now possible for you to determine exactly the operating efficiency of your Diesel equipment and to make any necessary adjustments long before trouble ever starts. This service is available on request, in most of the important industrial cities East of the Rocky Mountains.

Tests already have resulted in considerable savings in fuel and overhaul costs to many operators. So to make sure your Diesels are in perfect working order, ask for a DIESEL HEAT PROVER test of your equipment today. There is no cost or obligation. Write to Cities Service Oil Company, Room 1728, Sixty Wall Tower, New York 5, N. Y.



THE CITIES SERVICE DIESEL HEAT PROVER is easily portable—can be used without interrupting operation of equipment. Here it is connected with the engine's generator—and is being used to take a sample of gas at the exact moment when an exhaust port opens.

OIL IS AMMUNITION—USE IT WISELY!

CITIES SERVICE OIL COMPANY
NEW YORK · CHICAGO
IN THE SOUTH
ARKANSAS FUEL OIL COMPANY
SHREVEPORT, LA.

Dearborn Engineer believes in PREVENTIVE TREATMENT in your boiler room!

Preventive treatment gets to the root of boiler trouble. By anticipating the undesirable effects of the feed water supply, Dearborn Engineers can prevent damage to equipment and at the same time extend boiler operating periods so that maximum efficiency in boiler operation can be maintained.

Under ordinary operating conditions the necessity for repairs, due to improper water conditioning, is bad enough, but it is intolerable today when every ounce of steam that can be produced is needed in full time war service.

Replacement and Repair Parts are not readily available

Extensive tube replacements, for example, cannot usually be made on the spur of the moment. Priorities and allotments have to be considered. Dearborn Preventive Treatment therefore is of great importance.

Dearborn Engineer works right along with you in your boiler plant to forestall and prevent water troubles. He makes the necessary tests and takes on-the-spot steps to overcome any trouble which has started. If you are not using this service, call us. There is a Dearborn Engineer nearby to survey your plant, furnish correct treatment, supply expert engineering service, and make frequent and periodic checks to keep your boilers operating over long periods at top efficiency.

DEARBORN CHEMICAL COMPANY
Dept. F, 310 S. Michigan Ave.
Chicago 4, Illinois

Dearborn
TRADE MARK REGISTERED

BOILER WATER TREATMENT AND SERVICE

•[*For Victory, Buy United States War Bonds and Stamps*]•

"SAWING WOOD AND SAYING NOTHING". . . . *an old American saying*

Sawing ~~Wood~~ Steel

Billet saw preparing material for steam drop hammers at Vogt plant.

and keeping WAR PRODUCTION MOVING FASTER FOR VICTORY

We're attending strictly to business here at Vogt's and quickening the tempo of War Production without fuss or feathers. Vogt Products for Power Plants, Chemical Plants, Oil Refineries, Ship Yards, Powder Plants, Synthetic Rubber Plants, etc., are being delivered in ever increasing volume to meet the requirements of the War Program FOR VICTORY!

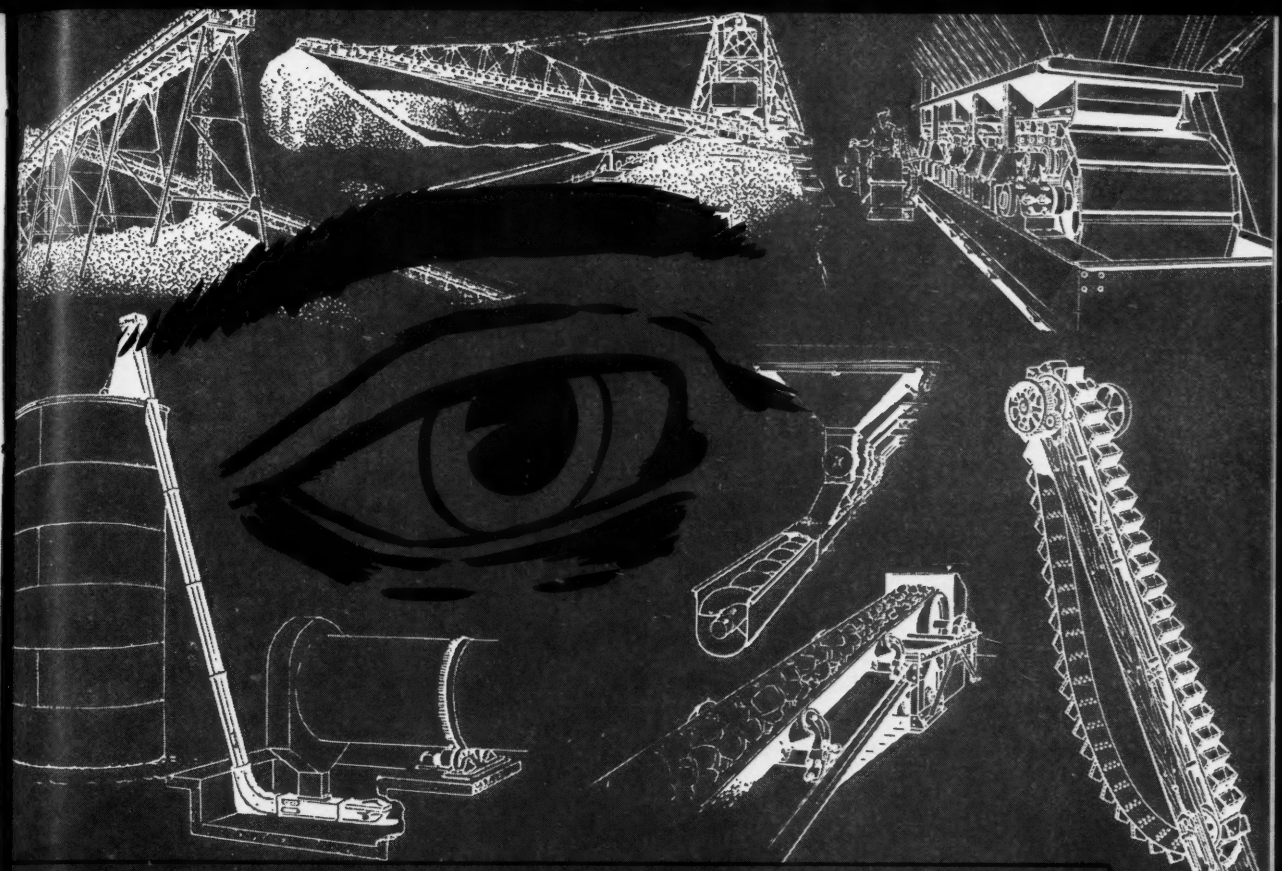
Vogt

PRODUCTS HAVE GONE TO WAR

- ★ DROP FORGED STEEL VALVES FITTINGS AND FLANGES
- ★ OIL REFINERY AND CHEMICAL PLANT EQUIPMENT
- ★ WATER TUBE BOILERS
- ★ ICE MAKING AND REFRIGERATING MACHINERY
- ★ HEAT EXCHANGERS

BUY WAR BONDS AND GET IN THE SCRAP

HENRY VOGT MACHINE CO.
LOUISVILLE, KY.
Branch Offices: NEW YORK PHILADELPHIA CLEVELAND CHICAGO DALLAS



Look at Your Conveyor Problems

Through *Experienced Eyes*

In your industry, yours are the experienced eyes. We, at Stephens-Adamson, have the trained and experienced eyes in the material handling field.

Here are competent engineers (who have spent entire careers with this company)—ready always to help you gain an objective view of your conveying problems. For them, the highest goal is the installation of the right conveying system for any specific job . . . Here are men thoroughly qualified to go over your present or anticipated operations with one constructive aim — to discover faster, safer, low cost ways of moving materials.

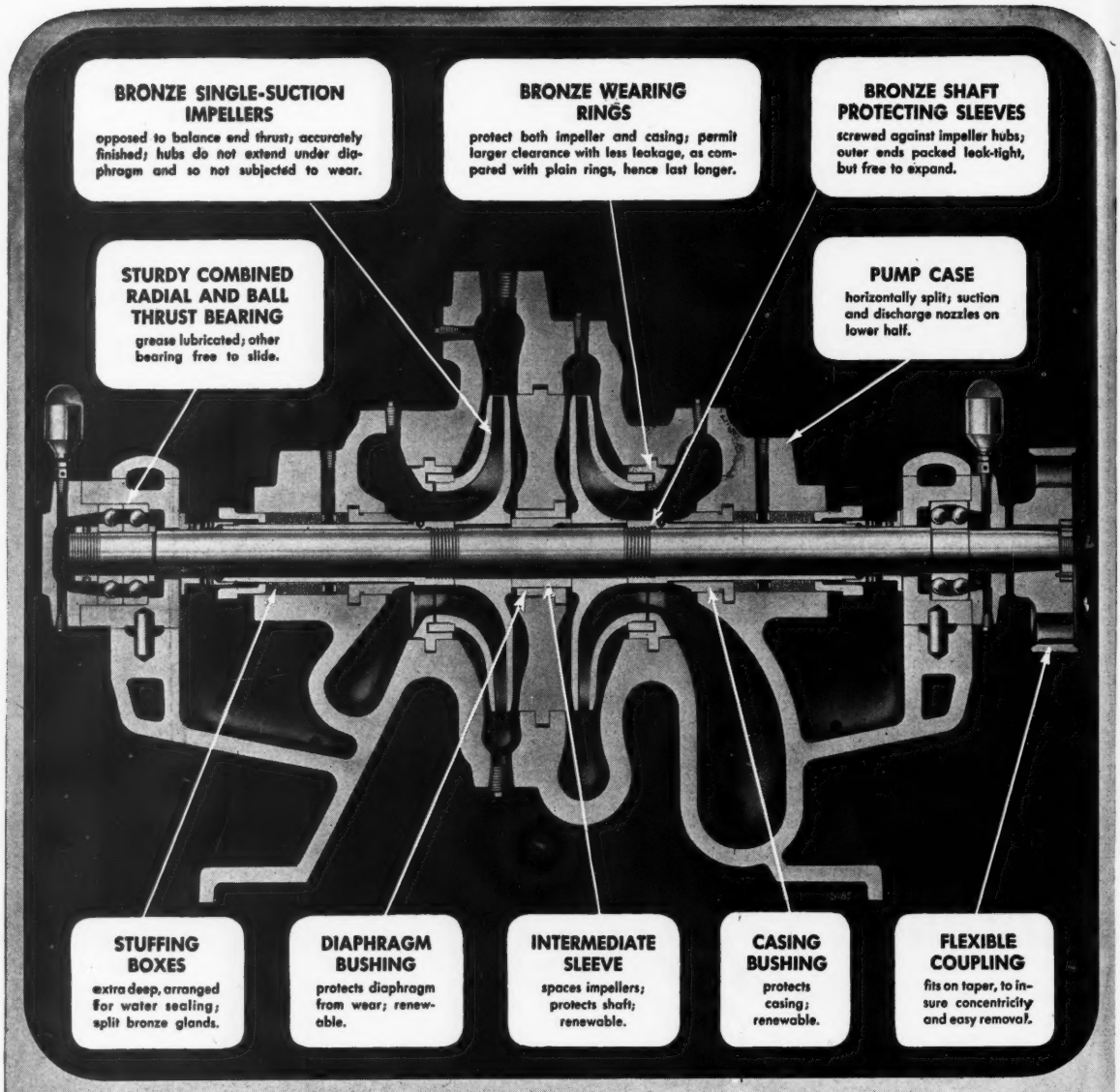
This is most significant when you start thinking—as we already are—about post-war conveying problems connected with new processes, new materials, new finished goods you may have in mind. Call in an S-A engineer to give you sturdy pegs on which to hang your thoughts.

STEPHENS-ADAMSON MFG. CO., 515 Ridgeway Avenue, Aurora, Ill.

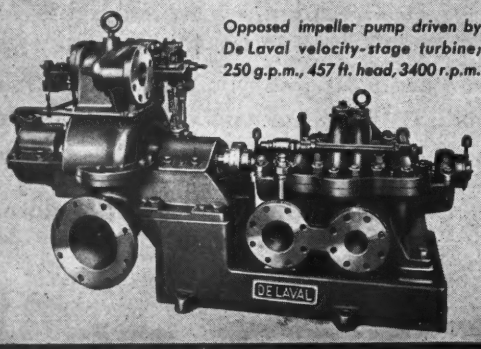
STEPHENS-ADAMSON MFG. CO.

Designers and Manufacturers of All Types of

BULK MATERIAL HANDLING EQUIPMENT


BRONZE SINGLE-SUCTION IMPELLERS
opposed to balance end thrust; accurately finished; hubs do not extend under diaphragm and so not subjected to wear.
BRONZE WEARING RINGS
protect both impeller and casing; permit larger clearance with less leakage, as compared with plain rings, hence last longer.
BRONZE SHAFT PROTECTING SLEEVES
screwed against impeller hubs; outer ends packed leak-tight, but free to expand.
STURDY COMBINED RADIAL AND BALL THRUST BEARING
grease lubricated; other bearing free to slide.
PUMP CASE
horizontally split; suction and discharge nozzles on lower half.
STUFFING BOXES
extra deep, arranged for water sealing; split bronze glands.
DIAPHRAGM BUSHING
protects diaphragm from wear; renewable.
INTERMEDIATE SLEEVE
spaces impellers; protects shaft; renewable.
CASING BUSHING
protects casing; renewable.
FLEXIBLE COUPLING
fits on taper, to insure concentricity and easy removal.

DE LAVAL *OPPOSED* IMPELLER PUMP



Opposed impeller pump driven by De Laval velocity-stage turbine; 250 g.p.m., 457 ft. head, 3400 r.p.m.

In this pump the two single-suction impellers have their suction inlets facing outwardly, thus balancing the pump hydraulically and requiring only two pairs of wearing rings. High efficiency is thus combined with simple construction. Pumps built in capacities up to 1500 g.p.m. and for heads up to 800 ft. Ask for Catalog P-3226.

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Scovill Tube News

SCOVILL MANUFACTURING COMPANY, Waterbury, Conn.

Factors Affecting War-Time Efficiency of Condenser and Heat Exchanger Tubes

The widespread use of copper and copper alloys in heat exchanging equipment is due in some measure to the many favorable physical properties of these materials, i.e., their ductility, toughness, strength, high thermal conductivity, etc., over a wide range of temperatures and pressures. The excellent corrosion-resistance of the copper alloys under most operating conditions, however, is of major importance in this application. The ability of copper and its alloys to withstand the corrosive action of such media as fresh and salt waters, sewage, hydrogen sulphide, acids, alkalis, etc., is of a high order and has established their value in tube form in contact with corrosive media. They have proved their dependability and economy under such conditions as well as under wide fluctuations of temperature, pressure and velocity of the circulating media.

Serious corrosion of condenser and heat exchanger tube does occur, however, particularly when corrosive conditions are admittedly very severe and such corrosion may result in considerable expense, costly delays and shut-down of equipment. In many cases, no improvement in tube life can be expected under existing conditions; in other cases, however, it has been possible to reduce or retard corrosion materially and obtain improved tube performance either by slight changes in operating conditions, by attention to certain operating details or by a change from one tube alloy to another which is more corrosion-resistant to the particular service conditions. For this reason, an appreciation of the factors which contribute to corrosion of tube materials is often of value to a better understanding of corrosion problems; this knowledge, in turn may be used to advantage in combatting such problems and in improving tube life. The subject is considered of sufficient importance to tube users to warrant discussion of the more important matters pertaining to corrosion problems.

"Service in Manuals" Designed for Scovill Customers Now Freely Available to All War-time Tube Users

The "service in manuals" begun by Scovill years ago to assist customers in choice of alloys to fit specific corrosion and installation conditions, is now proving useful to many war-time firms faced with increasing need to conserve scarce tube metal. You may find in Scovill's "Condenser Tube Booklet" just the information you need — diagrams, formulae, lists of alloys — to make your condenser tubes serve you better and longer. Write Scovill Manufacturing Company, 17 Mill Street, Waterbury, Conn.

Factors Affecting Tube Life

The service life of condenser and heat exchanger tubes is governed by the following major influences:

1. the composition of the alloy
2. the workmanship and quality of the tubes
3. the conditions of service of the tubes

The most satisfactory tube service and tube performance in a heat exchanger unit is obtained only after a careful consideration of these factors.

The Composition of the Alloy

The nonferrous alloys for heat exchanger service may be grouped into three broad classifications, as follows:

(a) Copper, Phosphorized Copper and Arsenical Copper

(b) Brasses or Copper Zinc alloys, usually containing small percentages of other metals such as Tin, Aluminum, Nickel, Iron, Lead, etc.

(c) Copper Nickel alloys, containing Copper, Nickel and, in some cases, minor amounts of other elements such as Tin, Iron, Manganese, Zinc, etc.

Scovill offers a complete range of tube alloys.

Muntz
Admiralty
Phosphorized Admiralty
Red Brass
Deoxidized Copper
Arsenical Copper
Aluminum Brass
70-30 Copper-Nickel
80-20 Copper-Nickel

Each of these has special characteristics which make it particularly suitable for use under certain conditions.

Scovill can place at your disposal the advice and consultation of men with years of experience in practical tube problems.

A Scovill tube material or method of installation may be of aid to you in obtaining longer tube life.

Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

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For Every Power Plant Need

As a major producer of heat interchange equipment, Lummus designs and builds a complete line of

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LUMMUS

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The Springfield Sectional Header, Horizontal Cross Drum Boiler is lighter in weight and more compact than other designs. Springfield units are readily adapted to suit restricted space requirements.

SAVE MAINTENANCE

Every pressure part of the entire boiler is of steel. Headers and mud drum are made of cast electric furnace steel, with which corrosion and pitting are minimized even under the most severe water conditions. All parts are easily accessible. Restricted steam delivery to the drum above water level reduces "carry-over." Springfield boilers are widely known as "dry-steamers".

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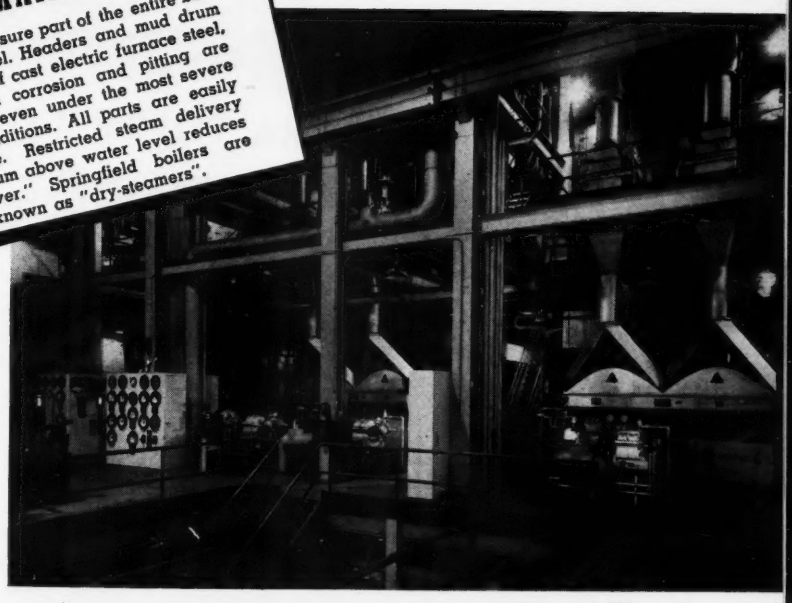


SAVE STEAM COSTS

The Springfield exclusive staggered tube arrangement, in four-tube groupings . . . the use of 3" tubes . . . sectional baffles of permanent construction . . . these and other Springfield features are reflected in lower exit gas temperatures—i.e. lower steam costs.

SAVE ENGINEERING

Complete drawings, patterns, etc. are on hand to produce duplicate units of many of the great number of modern Springfield generating units built in recent years. Springfield boiler design permits faster fabrication and faster erection.

SAVE TIME

With Springfield Boilers 30 to 60 days may be saved on erection time because of sectional design. Tubes are rolled in the sections and tested before shipment. All parts may be passed through small openings. Only a few boiler tubes need be expanded during erection. Sections may be erected in advance of the drum.

SAVE MONEY

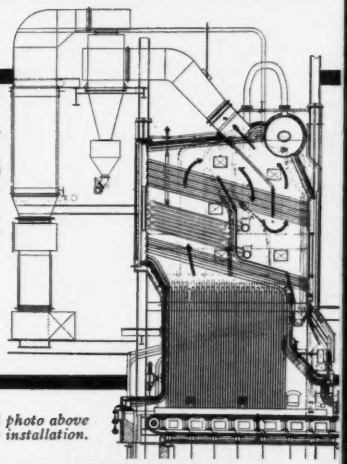
Savings in boiler steel, foundations, masonry work, erection and shipment time, and the economy inherent in the design of the boilers, make Springfield steam generating units among the lowest in boiler cost per thousand pounds of steam.

Can you match these Boiler Savings?

CAPACITIES of Springfield boilers range from 5,000 to 450,000 lbs. per hour, or more. Pressures from 75 to 750 lbs. or higher. Springfield also makes high capacity water walls, to secure higher capacity with existing boilers, and to provide the maximum in overload capacity with new installations. Contracts taken for complete steam generating units. Write for information. SPRINGFIELD BOILER COMPANY, 1951 E. Capitol Ave., Springfield, Illinois.

Some Springfield Boiler Users .

South Pittsburgh Water Co., Pittsburgh, Pa.—4 plants.
Inland Steel Co., Indiana Harbor, Ind.—6 boilers.
Anaconda Copper Min. Co., Cananea, Sonora, Mex.
State of Illinois (over 40 units in State institutions)
Hell Gate Station, United Elec. Lt. & Power, N. Y. C.
East River Station, New York Edison Co., N. Y. C.
Sherman Creek Station, New York Edison Co., N.Y.C.
Iowa Elec. Lt. & Pow. Co., Cedar Rapids & Boone, Ia.
Princeton University
Carnegie Institute of Technology
University of Illinois
University of Wisconsin
Deere and Company
Northern States Power Co., Minneapolis, Minn.
Anheuser-Busch Co., St. Louis, Mo.
Owens-Illinois Glass Co., Alton, Ill.
hundreds of others, in the U. S. and abroad.



Boiler diagram at right and photo above show University of Illinois installation.

SPRINGFIELD

STEAM GENERATING UNITS

SPRINGFIELD BOILERS

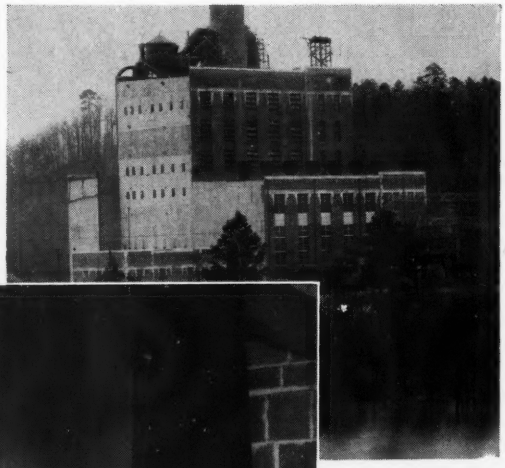
ANY SIZE ANY FUEL ANY PRESSURE

ALABAMA POWER COMPANY BUYS A SECOND AMERICAN CRUSHER ...for Low Cost Coal Sizing

HIGHLY satisfactory operating experience with the first crusher installed back in June, 1929, guided the Alabama Power Company's engineers in selecting a second AMERICAN Type 38-S Crusher when load conditions at the Gorgas, Alabama, plant called for more coal crushing capacity.

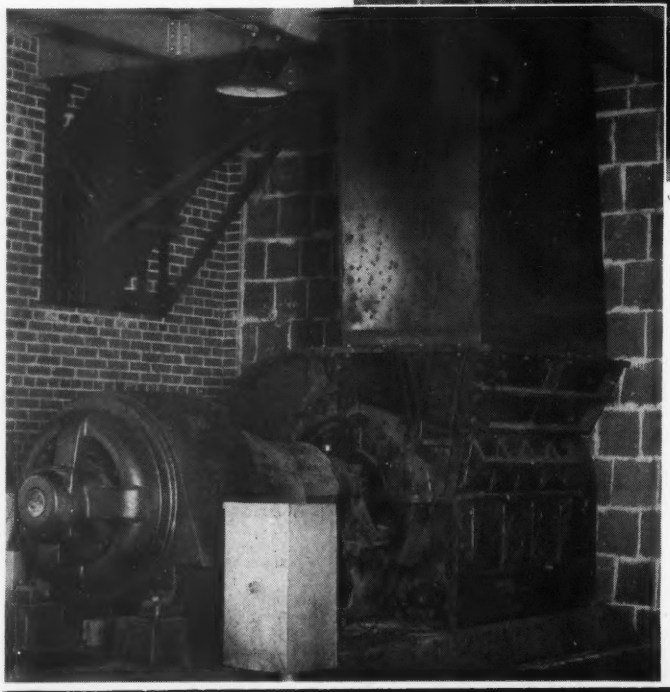
According to the report the total cost of maintenance on the initial AMERICAN Crusher over a service period of 14 years at this plant was less than $2000.

The money saving experience of this busy utility plant is being duplicated in scores of industrial plants and central stations where AMERICAN Crushers—used in either stoker or pulverized coal burning — are reducing total fuel costs from 2½ to 8%.



Above: View of Gorgas Steam Plant of Alabama Power Company.

Below: Original American Type 38-S Crusher installed at Gorgas plant; capacity 200 tons per hr.



AMERICAN Rolling Ring Crushers differ from other centrifugal crushers in that their housings are heavy steel castings, reinforced with ribs making them unbreakable from any crushing strain. Material to be crushed is struck by rings in suspension which shatter and distribute the coal before it reaches the breaker and grinding plate. By a simple adjustment of the patented grinding plate (made of manganese steel to insure long wear) run-of-mine or lump size is reduced to proper size in one operation.

AMERICAN Ring Crushers have capacities of 25 to 500 tons per hour, are built special for each installation and guaranteed for definite performance. Let AMERICAN Crusher engineers cooperate in getting better coal sizing and lower steam costs in your plant.

Write For Free Data Book On Coal Sizing

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1429 Macklind Avenue
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ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

HERE'S NEW Double-Trouble for V-Belt Wear!

1

BUY THE BEST BELTS:

You'll get the "jump" on maintenance with Texrope Super-7's design-against-wear construction! 20% *more* pulling cords. 50% *greater strength* in every one because they're made by the special Flexon process. That adds up to extra pulling power, less stretch. A cool-running rubber cushion fights flexing heat. Tough Duplex-Sealed cover seals belt against grit, grime, and moisture. When you *do* need new belts *invest in the best* — Texrope Super 7!

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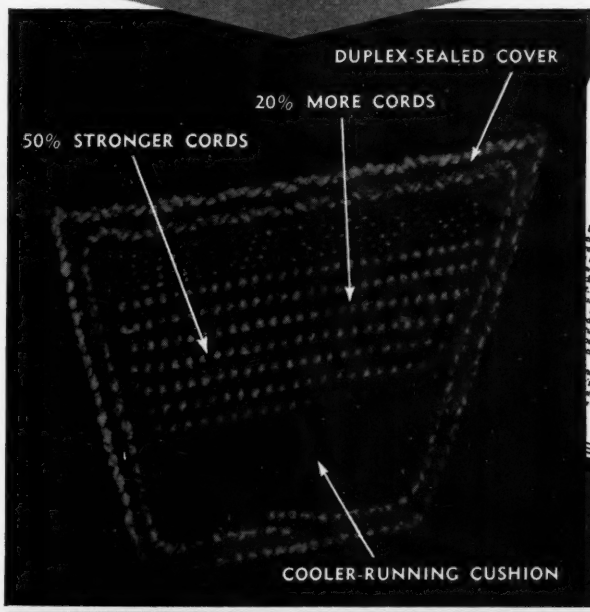
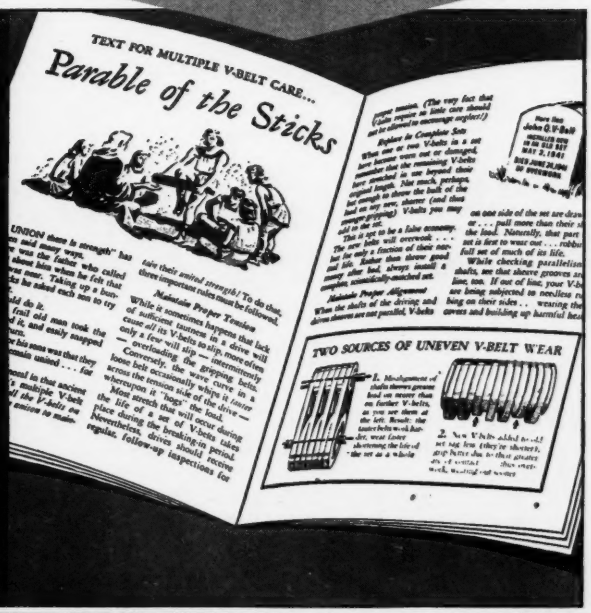
Over 75,000 men in industry are getting a head start on longer V-Belt life because they've got Allis-Chalmers' new handbook: "Plain Facts on Wartime Care of Rubber V-Belts." It gives you the inside story on "how V-belt anatomy affects maintenance"... "good-rule-of-thumb for tension"... a lot of other tips. Excellent for training new men, it's packed with valuable data. For your *free* copy, tear off the coupon and send today.





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More than 250,000 Yarways have been sold—purchased on their performance. Users report that *quicker heating* and *greater sustained heating efficiency* soon pay for their installation and continue to return *worthwhile profits in plant operating economy.* Then, too, the Yarway Trap's *small size saves space.* Its *light weight simplifies installation.* Its unique design with *only one moving part* and its *rugged barstock construction,* keep down maintenance expense.

And when you consider that *their purchase price* is usually *no more than the cost of repairing* an *ordinary steam trap*—why not get Yarway performance for your money?

A nearby Mill Supply Dealer handles Yarway Impulse Steam Traps; or write for Catalog T-1737.

YARNALL-WARING COMPANY, 114 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

Engineers' Civic Responsibility

By D. ROBERT YARNALL

SOMEONE casually reminds us: "A man is born a citizen and he may become an engineer."

The Secretary of State, in a notable address, has presented a striking outline of the structure of peace. He calls for swift and effective action at the close of the war to relieve human suffering in war-devastated countries. He hopes for the pursuit within nations of political liberty, economic security, and social justice for all alike. He states the necessity of co-operation of all nations, including the United States, in establishing a genius to reduce armaments, to settle disputes by peaceful means, to reduce trade barriers, and to provide equal access to raw materials. "No nation," said the Secretary, "will find this easy. Neither victory nor any form of postwar settlement will of itself create a millennium . . . . . The vision, the resolution, and the skill with which the conditions of peace will be established and developed after the war will be as much of a measure of man's capacity for freedom and progress as the fervor and determination which men show in winning the victory."

Everyone expects engineers to design and build the sinews of war. Can they count with equal confidence upon them as citizens after the war not only to help beat swords into plowshares and spears into pruning hooks, but to help insure "that this nation under God shall have a new birth of freedom?" What is freedom for us? How secure is it?

Are we who have chosen engineering endowed by birth with "good citizenship" characteristics. Alas, far from it. Somewhere along the line with the help of good environment and sound training there must be built in us a sense of concern, a social conscience, that will not be satisfied with personal success within the bounds of our profession, desirable as this is, but will drive us on and out *with other citizens:*

(a) To carry our share of the burdens of world sufferings.

(b) To assume our constructive part in responsibility for good, wholesome government.

(c) To help in making secure those precious freedoms, among them the right without fear to write our Letter to the Editor.

Do you remember this warning in 1940, even before we were in the present war, by Hale Sutherland?

The time is ripe, however, for acceptance of our insistence that the engineering schools established a humanistic core of study, substantial and dignified, extending through all the years of the present programs, a core of study which will acquaint the student with the organization and operation of all the major elements of our democracy, its social, economic and political aspects.

Photo by Fabian Bachrach

Someone always suggests that this broader subject matter should be presented in two years of college work preceding the four years of technological curricula. You know this proposal has not won acceptance. No, I am sure the answer is not to be found in a longer course.

All citizens must have responsibility for our democracy, engineers no more and no less than other citizens. We should all highly resolve never to leave the country in the hands of any but the most competent.

May I make a plea here and now for this core of study "substantial and dignified" extending through all the four years of our engineering courses —courses which will teach the essential elements of our democracy. I would have the standard of performance just as high in this core of study as in thermodynamics or calculus, and satisfactory completion just as essential for graduation.

May I make another plea to you very wise and experienced educators? Please do not be indifferent to spiritual values in life, and *please don't "cold shoulder religion!"* In speaking of religion here we are not thinking of narrow sectarianism, but rather in broad, deep, all-inclusive, and personal terms.

We engineers have all so worshipped the specialization complex and the bread-and-butter side of engineering that we have missed the great chance to help make secure the better world we are now all desperately demanding. We have ignored "this binding element" in our complicated social relationships, saying to ourselves and our friends, "Let us get on with our profession."

I am one of these engineers who believe with Dr. Richard Cabot, in his "What Men Live By," a book much read during and after World War I, that there are four essential elements in the well-rounded life—work, play, love, worship.

No matter how perfectly we plan this core of study designed to build up a sense of civic responsibility in our engineering graduates, it will not be completely effective unless or until that Divine discontent within him drives him out and beyond the narrow confines or boundaries of his profession, and compels him to use his engineering gifts to work for the good of the community of which he is a part.

We are all baffled by differences in denominationalism, but because we may differ violently in politics is no reason why we should lose faith in or cease to struggle for our great concept of democracy. Fortunately, science and the things of the spirit are no longer looked upon as incompatible.

Let us remember that citizenship responsibility has its vital roots deep within the Christian fundamental "Love thy neighbor as thyself."

Our material growth has been and continues to be rapid and far-reaching —our research laboratories pour forth advances in pure science, new devices, new processes. For the years of peace just ahead could we even better afford to divert some of the precious time available to training engineers for direct responsibility of citizenship?

What value has all this material progress if by reason of neglect or difference we train engineers who are unmindful of responsibilities of citizenship?

What doth it profit a nation if it gain the whole world and lose its own soul?

D. Robert Yarnall, co-founder and chief engineer of Yarnall-Waring Co. is one of the country's leading practitioners of the principles he expounds here. He was born in Delaware County, Pa., was graduated from the University of Pennsylvania as B.S. in M.E. in 1901, M.E. in 1905. In 1942 he was made a Doctor of Engineering by Lehigh University. He was with Coatesville Boiler Works from 1902 to 1907, Stokes & Smith 1907-1912, vice-president and general manager Nelson Valve Co. 1912-1918. He was co-founder of his present company in 1912. He is also vice-president and director of James G. Biddle Co. In 1920 Mr. Yarnall served on important commissions to Germany organizing feeding for children; in 1924 he had charge of turning over the organization and supplies to German organizations for the American Friends Service Committee. In 1938, for this Committee, he organized refugee relief in Austria and in 1941, went to Great Britain to survey relief needs and food relief for mothers and children in France. He is director and vice-president of American Friends Service Committee, chairman of the board of Westtown School, president and director of Pendle Hill. He was director of American Engineering Council in 1928-34, vice-president Engineering Foundation 1936-37, is a fellow of the ASME, member of board of trustees Franklin Institute, member AAAS. The above material is from a recent address before the Middle Atlantic Section, SPEE, at Haverford College.

Keeping a Power Plant Force

A woman employee receiving instructions from an old operator at a gage panel at the head of a turbine in a plant of the Buffalo, Niagara & Eastern Power Corp.

The general situation in regard to maintaining a proper force of power plant operators to maintain the power service of the country at highest capacity and efficiency during the war, has not, in general, been a critical one. The fact that there is not now and never has been, a shortage of electric power at any point in our war program is proof of the effective work of the entire industry. The situation regarding operators has varied in different parts of the country. In some localities power plant operators have succumbed to the lure of high wages in war plants and have left their posts for these more glamorous jobs, others have joined the services, but considering the nation as a whole, the loss of men in power plants has not been too serious. In most cases enough of the old operators remained so that at least a working force was left to help train new unexperienced men, and even women. This employment of women in actual power plant work is such a spectacular and "human interest" innovation that is has received a great deal of attention, probably more than is warranted by the number of women so employed and the type of work they are doing in power plants. This influx of inexperienced men and women, naturally calls for training programs. In normal times the accepted method of training a power plant operator is to place the neophyte in the plant to work with the experienced men and to let the latter bring him up in the way they think he should go. With one or two new men this system is fairly satisfactory but where a comparatively large number of new unexperienced employes are involved more formal training courses are necessary. It is the purpose of the special articles in the first part of this issue, to discuss such training programs and to show insofar as possible what other companies have done in establishing and using such programs. Typical examples always mean more to an engineer than generalizations and these statements by various operating companies show how others have met the problems.

on The Job To Win The War

Good employee training programs are among the most important elements in modern industry. As Mr. Krug points out in this article on the wartime training of power plant personnel, it is fortunate that most power systems have recognized this fact for many years and as a result had training programs in effect when the war started that enabled them to meet the manpower shortage with better success than most other industries. While the kilowatt-hour output of the nation's electric systems increased 70 per cent from 1939 to 1943 the number of employees decreased 20 per cent during that time

By J. A. Krug

DIRECTOR, OFFICE OF WAR UTILITIES
Washington, D. C.

SINCE PEARL HARBOR, the trend of the nation's war production has been steeply upward, almost every month showing a substantial increase over the month before. During recent months, however, a disturbing tendency has become evident in that the production schedules for several important programs have not been met. Goals have been set at what might seem to be fantastic levels, but they are the goals which the country must attain if victory is to be won at the earliest date and with minimum casualties.

What explains the slackening tempo in the rate of increase in production? No single cause is entirely responsible. But it is clear that the shortage of labor—skilled or unskilled—is one of the most important contributing factors. Of several hundred war plants recently surveyed to determine why they are falling behind schedule, at least two-thirds indicated labor difficulties of one kind or another. In some cases, they report that they are unable to obtain sufficient labor. In other cases, seriously high rates of labor turn-over, coupled with difficult training problems, have impeded production. Other plants are behind schedule because of labor problems of subcontractors supplying component parts.

It is easy to understand why industry should find it difficult to meet the problem of labor supply for rapidly expanding production. The nation is building an Army and Navy which will require eleven million of our best young men. At the same time, manufacturing production has expanded from $57,000,000,000 in 1939 to an estimated $155,000,000,000 in 1944. The tremendous drain of men to the Armed Forces, plus the requirements of new war industries, were bound to stretch the manpower resources of the country to the limit. It will require all of American ingenuity to solve the problem. This is not a job for Government alone. It is a task of such proportions as to require the concentrated efforts of labor, management, civic groups, as well as the various government agencies—federal and local. The labor situation is peculiarly a local problem. Conditions vary widely from place to place, and by and large the solution must be found in terms of specific areas and, frequently, of an individual plant.

Considering this overall picture, it is well for us to review the problems of the power industry with respect to labor supply. Up to now, the power systems of the nation have been able to expand production to meet all requirements and, at the same time, maintain a surplus to meet unforeseen contingencies. Power has never been "too little or too late." This has been true despite the fact that power planning must be ahead of general war planning by at least a year. In this connection, a few statistics are interesting. Kilowatt-hour output has increased from 130 billion kwh in 1939 to approximately 221 billion kwh estimated for 1943. In contrast, the number of people employed by electric utilities—both privately and publicly owned—has decreased from about 300,000 in the summer of 1939 to less than 240,000 in the summer of 1943. An increase of 70 percent in production has been obtained despite a reduction of 20 percent in the number of employees on hand to maintain service.

So far in the war, the utility industry has been able to hold its own not only in providing an ade-

The Author

J. A. Krug, Director, Office of War Utilities, has had wide experience in the engineering and management phases of utility operations. From his present post he has an unusual opportunity to see the power industry of the country as a whole. After graduation from the University of Wisconsin in 1929 (A.M. 1930) he served successively as research statistician, Wisconsin Telephone Co., 1930-31; chief of depreciation section, Wisconsin Public Service Commission, 1932-35; public utilities expert, Federal Communications Commission, 1936-37; and technical director, Kentucky Public Service Commission, 1937. He was appointed chief power engineer of TVA in 1938, and was made manager of power in 1940. In 1941 he became chief power consultant of the Office of Production Management, later the War Production Board and in January, 1943 was appointed to his present post.

quate power supply for rapidly expanding production, but also in maintaining a competent working force to assure continuity of service. Utilities throughout the country have a right to be proud of this great record, not only for what it means in the war effort, but for what it reflects in sound management, skilled and loyal employees, and good labor-management relationships.

To date, the problem of maintaining adequate power plant and system personnel has not been as serious as in certain other industries for a number of reasons. The decline in construction and maintenance activities because of material restrictions has reduced requirements for certain classes of labor and skilled help. Furthermore, the power industry is generally recognized as a stable one, and this has reduced the incentive for power employees to seek higher compensation in war industries where the duration of employment is uncertain. In most areas, the wage levels of power plant personnel are reasonably competitive, considering all factors, with the wage levels prevailing in war industries. A most important point, however, is that power companies have developed modern techniques for personnel recruitment and training. These methods developed in peace time have been most helpful in assuring an adequate personnel to meet wartime emergency.

It is true, of course, that conditions vary widely as between companies, and what is here stated as a general summary of the situation does not apply to the problems of each power system and power plant. A number of systems have had and are now facing the most serious problems in maintaining required personnel, and it is well to keep in mind that the critical period still lies ahead. While substantial contributions of manpower have already been made by utilities to the war effort, the drain will continue.

The Army and Navy will not reach full strength until next year and many war industries are still expanding. Selective Service is reaching a point where its effect on the employees of power systems will be greater than ever. This will be particularly true when it becomes necessary to induct fathers with dependents, as power plant personnel includes a very substantial number of young married men who have not as yet been called, because of their dependency status. It is, therefore, of greatest importance that power management perfect its personnel planning for meeting the conditions which will certainly arise. Such a program would include first, a careful survey of personnel requirements, taking into account the impact of Selective Service and loss to war industries as well as normal separations; and second, a detailed plan for obtaining replacements as needed to meet estimated requirements.

Fortunately, power managers generally have had long experience in this field. This may explain why few power companies have found it necessary to seek the cooperation of the War Manpower Commission in the development of Replacement Schedules or Manning Tables. These devices, however, are valuable aids in the solution of the manpower problem, and even those power systems which feel confident of their ability to meet the situation should take the precaution of becoming thoroughly acquainted with their use. So far, less than 40 percent of the utility companies have developed Replacement Schedules, and less than two dozen are using Manning Tables in cooperation with the WMC.

The task of replacement is, of course, minimized by doing everything possible to reduce labor requirements and labor turn-over and by organizing thoroughly for the job of recruitment and training. A number of measures have been found helpful in this regard, including

(a) the development of stabilization agreements with other industries in the area competing for the same labor supply,

(b) up-grading of employees now on the payroll in order to obtain maximum utilization of personnel,

(c) employment of additional women, and

(e) development of suitable training programs for new and existing employees.

A. Stabilization Arrangements

Prior to the establishment of the WMC, many utilities established cooperative relations with other employers covering recruitment and employment. These arrangements tended toward stabilization and avoidance of piracy. Employers agreed to make offers of employment to employees of other systems and competitive industries only through the employer and to make offers of employment only when the employee could be released without prejudice. At the same time, power systems having employees to release, or recruitment prospects in excess of need, furnished lists of such qualified personnel to those systems needing additional help. During recent months, the WMC has developed enforced stabilization plans in certain areas, but it is still too early

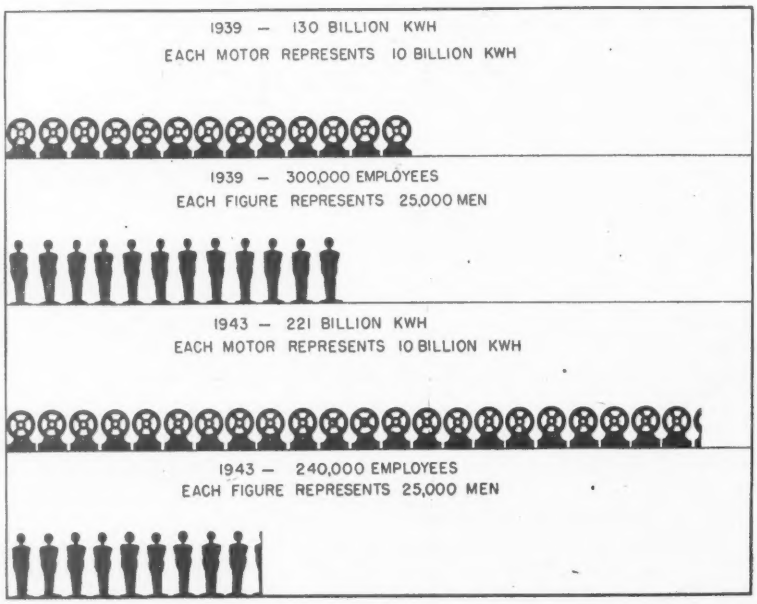

1939 — 130 BILLION KWH
EACH MOTOR REPRESENTS 10 BILLION KWH
1939 — 300,000 EMPLOYEES
EACH FIGURE REPRESENTS 25,000 MEN
1943 — 221 BILLION KWH
EACH MOTOR REPRESENTS 10 BILLION KWH
1943 — 240,000 EMPLOYEES
EACH FIGURE REPRESENTS 25,000 MEN

Fig. 1. Chart showing the relation between the number of employees and the kilowatt-hour output of the utilities during the years 1939 and 1943

to pronounce any final judgment on these plans.

B. Better Utilization of Existing Employees

Better utilization of existing employees through up-grading and through more efficient staff organization offers a valuable means of alleviating the employment situation. Attention should be centered upon all possible means to this end. Many power companies are carefully reviewing the skills and abilities of their employees, and each employee is transferred to the position where he can make the maximum contribution considering his particular skill and aptitude. The national policy of extending the work week to 48 hours has also assisted in obtaining better utilization of individual employees.

It is encouraging that the wartime squeeze on manpower has led to the streamlining of many organization structures. It is inevitable with the passing of years that many companies have built up top-heavy and unwieldy organizations. Furthermore, most power systems have had a number of employees who served a desirable function in peace time, but who were dispensable in wartime. This includes, of course, much of the sales organizations and in some instances employees responsible for public relations and long-range research. Progressive power management has done everything possible during the war to release every employee who is not absolutely indispensable in order to make the maximum contribution to the nation's manpower resources.

C. Employment of Additional Women

It is of special interest that in areas of extreme labor shortage, power management has found the greatest possibilities for utilization of women. In areas where the labor market is comparatively easy, utilities have insisted that women can be used only for unskilled or semi-unskilled work. In tight labor markets, however, women have been trained for some of the most difficult technical and operating assignments. Furthermore, they have proved particularly effective in areas where the loss of manpower to the draft and to war industries has been serious among young technical men and trained operating personnel. In many cases, it proved impossible to fill these positions from the older men already on the payroll or through recruitment of qualified men from outside. Through careful training, women have been equipped to act as assistant operators, technicians, and in some instances even as boiler room help. It is evident that with careful training women can make a real contribution to the operation of the nation's power resources in time of war.

D. Training of Personnel

It is indeed fortunate that most power systems have devoted many years to the development of personnel organization and training programs. For those with such programs in effect, the war has required only an expansion readily possible within the framework already established. For many utilities the expanded training activity involved placing the training programs directly in the plants where the courses could be carried out by the employee while actually on the job. In such cases, the training is conducted by designated persons in the plant and the lessons worked out by the trainee are graded by the plant supervisor and submitted to the general personnel office for recording. This plan has made it possible to train additional people without material loss of time and has been especially useful in the up-grading of existing personnel. Other power companies have expanded training opportunities through the establishment of additional night courses at local vocational schools and other educational institutions. For the most part, training of employees within the industry has been carried on by personnel organizations established and perfected in peace time.

Sound training programs have other advantages besides the rapid development of additional skilled workers. They result in uniformity of practice which often makes for more efficient operation. Where men are instructed haphazardly under older operators, they do not all learn to do the same things in the same way. With training programs, all the new men receive the same instruction and operating practice tends to become more uniform.

It is not my purpose to attempt a detailed discussion of the best methods for training power system personnel or to explain in any detail how such programs are organized and started. Plant operators should have in mind, however, that the Government has established a sound Training Within Industry Program in order to help industry help itself with employment problems. The underlying purpose of this program is "to assist war production to meet the manpower needs by training within industry each worker to make the fullest possible use of his best skill up to the maximum of his individual ability, thereby enabling production to keep pace with war demands."

These objectives are accomplished by three programs offered to industry through the War Manpower Commission: Job Instructor Training, Job Methods Training, and Job Relations Training.

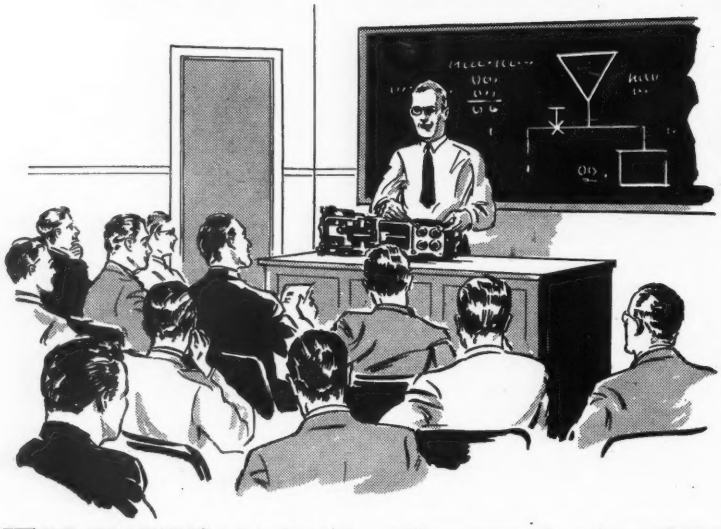
Job Instructor Training shows supervisors how to train personnel quickly in order to develop replacements as speedily as they are required to fill requirements.

Job Methods Training is the a-b-c of methods engineering. It shows plant supervisors how to make the best use of equipment, materials, and manpower now available. It strives to develop short cuts and improve methods now in use.

Job Relations Training deals with the general problem of getting along with people. It emphasizes the common things and day-by-day courtesies that everyone knows but frequently forgets during periods of stress and emergency.

Some of the most progressive utilities, including some with the best training organizations, have adopted and are now using the Government's Training Within Industry Program and are finding it most effective. There is, of course, no magic way for training plant supervisors to do better jobs or for training employees to do the difficult and complicated jobs of operating and maintaining our power plants and power systems. It is a task which must be undertaken and organized by top executives and made an operating responsibility of competent personnel throughout the organization. There is no more important service to the war effort than power supply and no more important part of our manpower resources than the men and women who operate our power systems. A concentrated effort should be made to take full advantage of all of the training technique within the industry and all of the training programs offered by the Government. We have the plants to do the job and the materials to do the job, and I am confident that the competence and resourcefulness of power system management will see to it that we have the trained personnel to keep every plant humming for the duration of the war.

Employee Training in THE POWER INDUSTRY



By N. E. FUNK

Vice President in Charge of Engineering
Philadelphia Electric Company

In 1915, after building a large addition to the Schuylkill Station, the Philadelphia Electric Co. found it desirable to write operating instructions for the operators covering the new equipment, which had no counterpart in the old equipment. These instructions aided so much in training personnel that from them the company developed an Operating Handbook covering all phases of power station operation. This, revised and expanded, still serves as the basis for all employee training. This article gives details of the handbook and its use. It also details a method for studying the performance of substation employees that is applicable to all operating personnel. This is a most practical discussion of one of the country's most effective training programs. It shows principles and practical details applicable in one way or another, on a large or small scale, to many power plant conditions.

THE TRAINING of industrial employees is not a new idea, but is as old as industry itself. From the beginning of the crudest type of industrial activity, knowledge of how to perform various operations was imparted to newcomers in the trade by imitating the performance of skilled artisans with no instruction as to cause and effect. This type of instruction continued for generations. It was only at approximately the beginning of the present century that the necessity for the formation of better training plans was recognized.

The development of electric utility personnel, so far as I know, was universally conducted in the pre-1900 fashion. There were no definite written instructions and the entire training of each individual was left to his immediate superior, by whom he was instructed in the operation of the piece of apparatus which he later was to control.

Those in charge thought this procedure developed a satisfactory operating personnel and in all probability they were correct, since the installations of that period were quite simple and most of the operations fairly obvious to anyone with mechanical inclinations. However, as installations became more complex, it was evident that instructions originally imparted to an operator, after having been transmitted orally several times in sequence, had little resemblance to the original, and it was possible for dangerous practices to creep into the routine operation in this manner. Distortion of information is a natural result of oral transmission of ideas. A man thoroughly familiar with his work is prone to take entirely too much for granted in transmitting information to the person he is teaching. Some of his actions have become so automatic that he assumes they must be perfectly obvious to the beginner.

Operating Handbook Developed

When the Philadelphia Electric Co. built, in 1915, what was then a large addition to the old Schuykill Station, it was felt desirable to write simple operating instructions for the new equipment installed there, which had no counterpart in the old part of the station. This aided so much in the training of personnel that it led to the development of an Operating Handbook covering all types of generating and substation operation, which, revised and expanded, is still in use as a basic means of employee training. It consists of three major divisions: the electric plant (both generating and substation), the turbine plant and the boiler plant.

The first page of a 10-page index for the electric plant only, Fig. 1, gives some idea of the extent of the material in this book. Section 4111, which is page 9 of the index, is reproduced as Fig. 2, to exemplify the manner in which the electrical end of a turbo-generator is put in service. A similar set of

The Author

Nevin Elwell Funk, vice president in charge of engineering of the Philadelphia Electric Co., Philadelphia, Pa., has been in the employ of the company since 1907. He was graduated from Lehigh University in 1905 with the degree of E.E. The University conferred on him the honorary degree of Doctor of Engineering in May 1943. Mr. Funk has been active in the affairs of the ASME and the AIEE. He was elected president of the AIEE for the year 1943-1944.

rules for the steam end of the turbine is included in the turbine plant section.

Employees are given the part of the Handbook that covers the work they are being trained to do and are drilled in the information therein contained, in parallel with instruction by the men actually operating the equipment. As soon as they are proficient in their immediate job, they are then given parts of the book relating to the operations of the next job in succession, so that they are continually being trained for advancement.

There is a basic difference in the training of industrial workers and power plant or substation operators. The routine functions of operation can be broadly classed in the same category as the training of industrial personnel, but to teach the employees to function properly when apparatus failures occur is an entirely different matter. In these cases the cause of the fault must be quickly determined and proper steps taken to correct it, accuracy and speed being of paramount importance, since the lack of them prolongs the duration of the fault with increased damage to apparatus. Actually passing through experiences of this kind is the only training which can be pursued; thus it follows that a fairly long period of time is required for an operator to experience sufficient incidents which he has performed satisfactorily to develop self-confidence in his ability to cope with any situation which may arise.

This latter requirement, while developed by the proper training, cannot be attained unless an employee has the proper psychological and physical reactions, and it is essential that time should not be wasted on an employee who fundamentally is not susceptible of development because of personal characteristics. The corollary of this, of course, is care in hiring those men who later may be developed for operating positions.

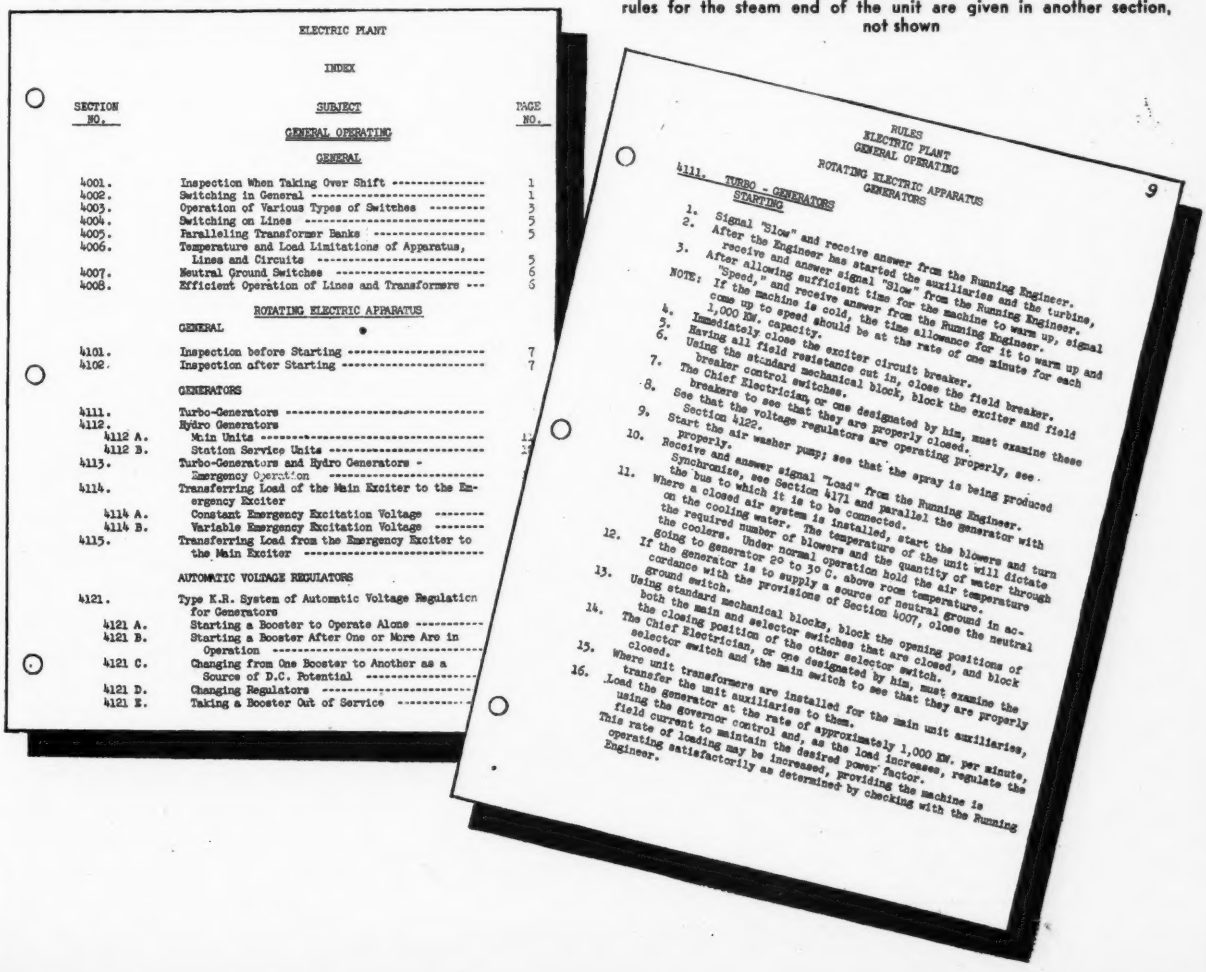
Determining Characteristics of Good Operators

This difficulty applies to all operating personnel, but greater difficulty is experienced in substation operation because employees are placed on their own responsibility in a shorter period of time, due to the small number of men at any one substation location. In spite of the greatest care in selection, experience indicated that personal judgment was a poor factor to rely on in determining a prospective employee's fitness, even when the prospect was interviewed by several men. In many cases, the most alert subjects were those whose nervous reactions were such that even after intensive training they almost universally acquitted themselves poorly in cases of emergency, while their operating performance under normal routine conditions was beyond reproach.

This led to an attempt to develop some method of detecting those whose personal characteristics prevented development into satisfactory operators. Realizing that this task required the services of a psychologist, Dr. M. S. Viteles of the University of Pennsylvania was employed as a consultant to the Substation Operating Department with the specific problem of first developing such tests for substa-

Fig. 1. (Left) First page of 10-page index of Operating Handbook for electric plant only

Fig. 2. (Right) Reproduction of Section 4111, page 9 of Operating Handbook covering starting instructions for the generator end of a turbo-generator. This page is shown indexed on Fig. 1. Starting rules for the steam end of the unit are given in another section, not shown



ELECTRIC PLANT

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RULES
ELECTRIC PLANT
GENERAL OPERATING
ROTATING ELECTRIC APPARATUS
GENERATORS

9

4111. TURBO - GENERATORS
STARTING

1. Signal "Slow" and receive answer from the Running Engineer.
2. After the Engineer has started the auxiliaries and the turbine, receive and answer signal "Slow" from the Running Engineer.
3. After allowing sufficient time for the machine to warm up, signal "Speed," and receive answer from the Running Engineer.

NOTE: If the machine is cold, the time allowance for it to warm up and come up to speed should be at the rate of one minute for each 1,000 KW. capacity.

4. Immediately close the exciter circuit breaker.
5. Having all field resistance cut in, close the field breaker.
6. Using the standard mechanical block, block the exciter and field breaker control switches.
7. The Chief Electrician, or one designated by him, must examine these breakers to see that they are properly closed.
8. See that the voltage regulators are operating properly, see Section 4122.
9. Start the air washer pump; see that the spray is being produced properly.
10. Receive and answer signal "Load" from the Running Engineer. Synchronize, see Section 4171 and parallel the generator with the bus to which it is to be connected.
11. Where a closed air system is installed, start the blowers and turn on the cooling water. The temperature of the unit will dictate the required number of blowers and the quantity of water through the coolers. Under normal operation hold the air temperature going to generator 20 to 30° C. above room temperature.
12. If the generator is to supply a source of neutral ground in accordance with the provisions of Section 4007, close the neutral ground switch.
13. Using standard mechanical blocks, block the opening positions of both the main and selector switches that are closed, and block the closing position of the other selector switch.
14. The Chief Electrician, or one designated by him, must examine the selector switch and the main switch to see that they are properly closed.
15. Where unit transformers are installed for the main unit auxiliaries, transfer the unit auxiliaries to them.
16. Load the generator at the rate of approximately 1,000 KW. per minute, using the governor control and, as the load increases, regulate the field current to maintain the desired power factor. This rate of loading may be increased, providing the machine is operating satisfactorily as determined by checking with the Running Engineer.

tion personnel, for there was a larger group of men doing similar tasks in this department, performing with different degrees of efficiency, who could be subjected to the tests and results compared with their actual performance. Thus a basic measure of the accuracy of the tests, as applied to practical operation, could be obtained.

The chief purpose of the study was to develop psychological tests which would measure the predisposition to make mistakes, so conspicuously present in the performance of the poorest group of operators and absent in the best group of operators. Three series of tests were finally chosen; the first two to be used in measuring the mental abilities and temperamental traits required for safe and accurate performance under normal operating conditions; the third for measuring the adaptability of the prospective employee to emergency conditions. The last was fundamentally a fear-reaction test which permitted the recording of changes in accuracy of the subject's response under disturbing conditions of electric flashover, noise, smoke and like conditions.

A group of operators was chosen whose performance records were available for a period of time. About 25 per cent of this group was composed of the best operators, 50 per cent with average performance and 25 per cent of the poorest operators. A comparison of the men's reactions to the tests with their actual performance indicated quite clearly that the tests definitely showed the predisposition of the men to make switching errors under both normal and abnormal conditions.

The selection of new substation employees on the basis of the tests was started in 1928 and, in addition, those employees who had not been in the test group were subject to examination. Operators were reassigned, based on the success with which they passed these tests, those with the best scores being placed in the larger and more complex substations, while those with the poorer scores (which fortunately also corresponded to poor working records) were assigned to the smaller, less complex stations.

A chart, Fig. 3, shows the reduction in operating errors from 1928 to 1942 inclusive, together with the increase in the company's output. The switching errors have been reduced from 37 in 1928 to 7 in 1942, while the load has increased 3⅓ times. That is, the actual relation of the switching errors to the output is approximately 5 per cent of that in 1928.

Correct Training Program Essential

Proper selection, however, is not the complete answer to satisfactory operating performance. No matter how correctly men may be selected to properly function in the prospective work, they cannot be expected to produce satisfactory results without proper training. The present method of training assistant substation operators is given as representative of the general method of training all operating personnel.

The Operating Department exercises executive authority in the detailed administration of the training course and conducts the training program through a Supervisor of Training. The Personnel Department functions in an advisory capacity in the administration and suggests extensions and development of the course with changing conditions.

A central training school gives that instruction which cannot be conducted conveniently in the stations. It includes the elements of electricity and operating principles of station equipment, which is limited definitely to the material necessary to understand the operation of the type of station in which the men are to be employed. The course parallels theory with station practice, and any theory that is not essential in the specific training is omitted. Attendance at classes is compulsory, the men are paid at regular rates, and allowance is made for excessive carfare or traveling time. The complete training requires approximately two years, during which time the Assistant Operator attends school for a 2½-hr session every two weeks.

Each new man hired by or transferred to the Operating De-

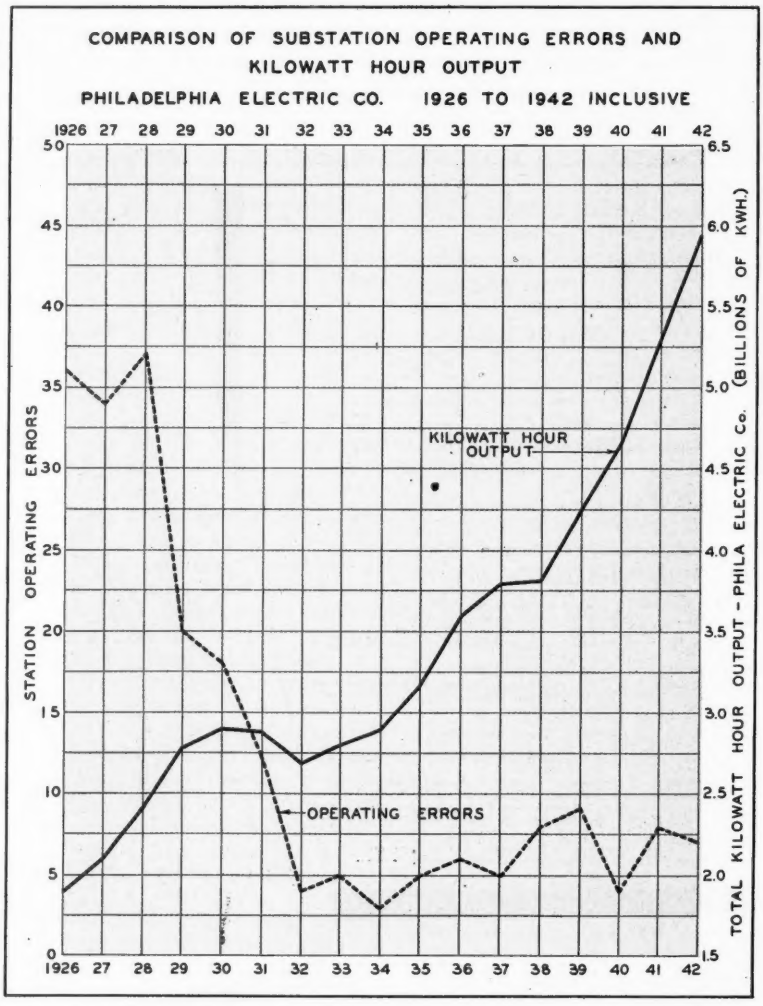


Fig. 3. Chart showing reduction in substation operating errors, 1926-1942, compared with increase in company's output

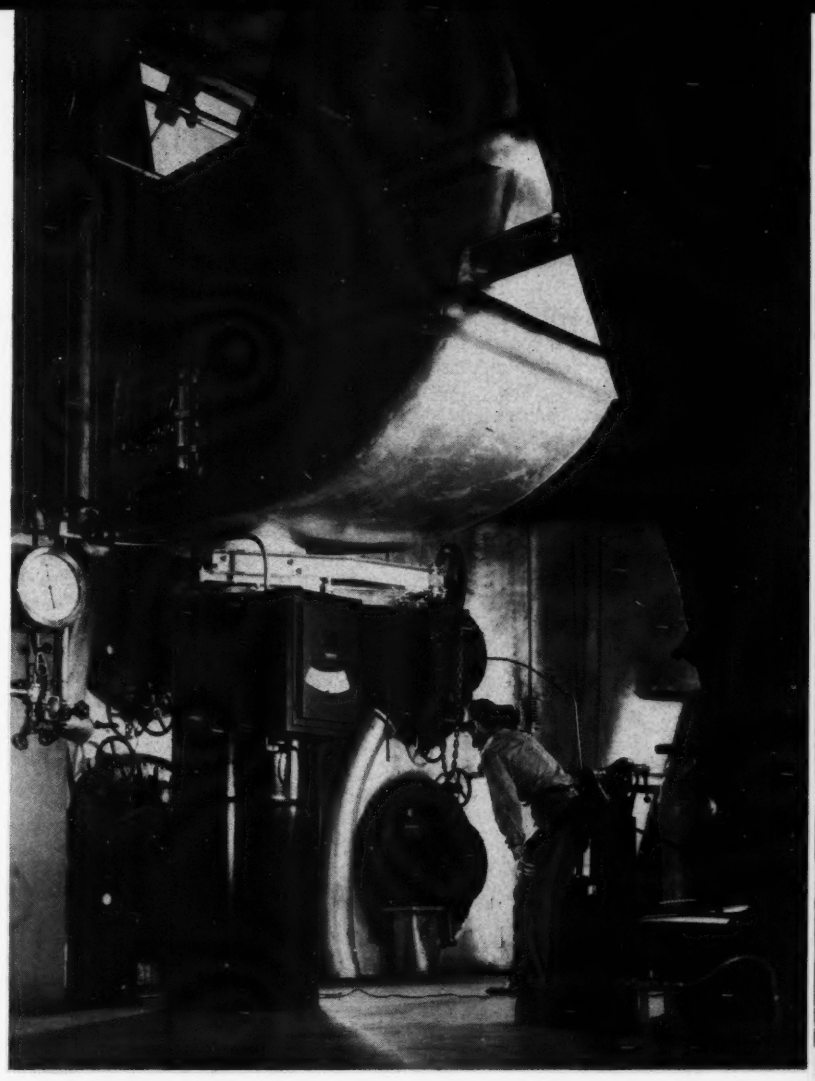


Fig. 4. Checking combustion in a modern boiler room

partment is assigned to one of the larger substations for initial training. The training in the substation consists of practical instruction in all of the duties of the substation operator. It is built around the substation equipment, and each training project is broken down into numerous items in order to simplify the instruction to a maximum degree. Thus, the amount of knowledge which a man must grasp at any one time is not so great as to discourage him and, as he gradually progresses in the project he will begin to develop confidence in his ability to master it. This instruction is the direct responsibility of the substation foreman, but it is not left to each individual's judgment to determine how or what he should do. Each project has been carefully laid out and each foreman has been taught the best method to follow in instructing new men.

At the completion of each section of the course the trainee is required to pass an examination on the problems he has been studying. He cannot continue his course until he has satisfactorily passed his previous assignments.

Each six months the members of the substation supervisory force, the Supervisor of Training and the Director of Personnel Research and Training meet to consider the progress of each Assistant Operator and make recommendations for promotion, demotion, transfer or dismissal, depending on his performance.

Requirements of a Good Training Program

I have only touched the high spots on this substation training course; a detailed description of it would require a book in itself. But any system of training, to be successful, must rest upon the fact that it actually produces results. It must be believed in both by the men who are responsible for producing results and by the men who are being trained. The policy of training is outlined as follows:

1—Training is primarily a function of management. Irrespective of his earnest desire to perform, no employee can produce the best results without adequate training.

2—Training is a function of the Operating Department. It should be carried on by instructors who are members of this department, who are responsible to the operating executives for results and who are closely in touch with the intricacies of operation.

3—Satisfactory training programs cannot be developed in a haphazard manner. They must be developed in conjunction with the operating forces by specialists in education who can guide those responsible for training along the lines of producing the greatest results with the least effort.

4—Training must be of a practical character. It should not be planned on the basis of replacing the functions of existing educational institutions. Any theory which is taught must be tied in directly with its particular application and only a sufficient amount of this type of training should be supplied to permit the trainee to carry on his work intelligently.

5—Training in the field must be synchronized with theoretical training so that there is a direct and easily-understood tie between the two.

6—Adequate records of men under training are essential to the development of the training program and to the most satisfactory utilization of the increased knowledge of the individual employee.

CORRECTION — DETERIORATION AND MAINTENANCE OF POWER PLANT STRUCTURES BY ARTHUR S. PEARSON

We regret very much an unfortunate typographical error in the article on the deterioration and maintenance of power plant structures by Mr. Pearson on page 60 of the August issue. In the by-line Mr. Pearson's name was listed as S. J. Pearson. It should have read Arthur S. Pearson. Another error appeared in the last paragraph on page 64 of this article. The sentence beginning with "Notwithstanding unfavorable—" should have read "Notwithstanding these favorable conditions—." Finally, all re-publication rights to this article are reserved by the author.

What Individual Companies Have Done in TRAINING POWER PLANT

Although a number of public utility organizations have conducted their own training schools and courses for power plant men, as illustrated in these pages, only a comparatively few industrial power plants submitted data on their formal training programs. That does not mean that they do not have them. However, it has been our observation during the past year or so that industrial power engineers have asked for guidance in organizing training programs more frequently than utility engineers. It is not that they are unable to formulate a program to fit their own conditions but that they seem to have doubts as to the correctness of any procedure they establish. They want to have some standard by which they can judge the correctness of their instruction. Here, in their own words, illustrated by typical pages, sketches and excerpts from the instruction material they use, are some comments from various utility and industrial companies on their individual methods. They can be used for guidance by other men who may have to face the same problems

THE AMERICAN ROLLING MILL CO.,
Ashland, Ky.
GEORGE M. COUGHLIN
Superintendent of Steam Power

WE STARTED an intensive training program last February (1943) and finished early in June. We found our training program quite effective and intend to carry on this fall, enlarging on the various subjects more than we did in the original program. We found the course very necessary, in that we expanded our organization 50 per cent because of the additional power plant which went into operation less than a year ago.

Attendance on the part of our employees was entirely voluntary and they received no extra pay for attending the classes.

We are not using women in our power plant operation jobs at this time, only in the power plant office.

(EDITOR'S NOTE—The course, in general, called for 10 hr on heat fundamentals, 6 hr on fuels and combustion, 6 hr on boilers and draft equipment, 8 hr on steam engines, turbines, pumps and lubrication, and 2 hr for miscellaneous subjects. Average number attending the class was 70, including a number of men from other industrial plants in town. A course outline or manual covering the above subjects was prepared as a foundation for the classroom work, based on parts of Croft's well-known power plant textbooks[1] but converted and adapted by Mr. Coughlin into his own language to a large extent. This was later mimeographed and a copy given to each member of the class. Figure 1 shows how this material was presented.)

These outlines were greatly expanded with blackboard illustrations and demonstrations. In addition to this outline we also used for text reprints of articles from technical magazines, on pumps and compressors also the Handbook for Wartime Care of Centrifugal Pumps recently published by Allis-Chalmers Mfg. Co.

For demonstration purposes we borrowed from the Babcock & Wilcox Co. a model boiler of the integral furnace type, a model pulverizer, and some sections of stud tubes. In addition, we had cast-iron blocks which we use to protect water walls in a stoker-fired boiler here in Ashland. The Babcock & Wilcox Co. furnished us with some of their advertising matter on the integral boiler They sent us a number of lantern slides illustrating different types and characteristics of boilers.

Worthington Pump & Machinery Corp. supplied a small centrifugal pump to be used in demonstrations, which certainly came in handy. Although I have about sixty centrifugal pumps, I could not take any of them out of service long enough for a demonstration.

The Allis-Chalmers Mfg. Co. furnished us with a new 16-mm talking film showing the action of steam in turbines.

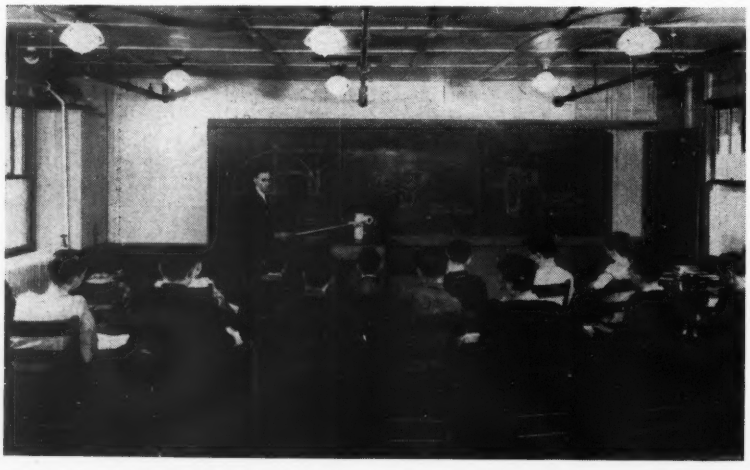
In addition, I had for use a small duplex reciprocating pump and found it quite valuable in illustrating that type unit and the setting of steam valves. We also made up some fair-sized cardboard models illustrating the operation of slide valves and Corliss valves. Of course we had our boiler tube turbines and some good samples of scale and different grades of firebrick. We illustrated convection currents and degasification of water, using large beakers and Bunsen burners.

We spent one entire class period teaching the use of the Orsat and draft gages and their application to boilers. We had large scale blueprints of small impulse turbines and pumps.

We have found that in teaching a class, the average student is much more receptive to sight than to sound and that points are better received when profusely illustrated on the board or with some equipment for demonstration.

We had one class of two hours each week and then repeated that class for the benefit of men who were on turn work and were unable to attend the first class. In this way all members could attend either one or the other sessions. Of course this meant four hours of teaching for myself, but the effects amply paid me for my trouble. We usually took about ten minutes rest period at the end of the first hour and then, for the benefit of those who wished, we had further discussions, answering any questions of immediate importance after the class was dismissed. We usually found two or three of the students waiting around for these sessions.

We found the class to be quite a chore not only in the teaching but in



A class room session of Mt. Vernon High School pupils at Cooper-Bessemer Corporation's plant

[1]**Power Plant Series: Practical Heat and Steam Turbine Principles & Practice, by Terrell Croft, McGraw-Hill Book Co., New York City.**

OPERATORS

preparing the subject matter each week.[2] We believe the class can be even more successful if more time is devoted to each subject. The first five lessons were mostly fundamentals in physics and chemistry and while they tended to become rather dry subjects we endeavored to lighten the weightiness as much as possible with plenty of laboratory illustrations.

IOWA-ILLINOIS GAS AND ELECTRIC COMPANY
Rock Island, Illinois
H. A. KLEINMAN
Electric Production Engineer

OUR EDUCATIONAL program has not been changed due to wartime conditions, but has been accelerated and emphasized so as to hasten the process of developing trained and experienced employees. The problem is one that must be promoted vigorously by those in charge of plant operations and the discussion leaders and instructors must be recognized as competent and well qualified to discuss the subjects announced.

Our educational work has developed over a period of years and has been designed particularly to cover the following four steps:

1. To break a new man into a job so as to get him started performing a duty necessary for the operation of the plant.

2. To give him information on the power production process so as to develop a background sufficient for him to choose the kind of work that appeals to him.

3. To offer specific courses to the men who have chosen a definite line of work and assist them in the completion of such courses.

4. To keep the older and experienced employees interested in their work and abreast of the times by encouraging them to subscribe to the technical and trade papers and offering lectures and discussion groups on the problems of power production.

The particular feature that I wish to call attention to at this time is the series of six or seven weekly meetings of one hour duration each, offered once or twice a year on company time, and designed particularly to give the new employee a background of knowledge about the process of converting coal to electrical energy. They also serve as a refresher course to the older employees, who are invited and encouraged to contribute to the discussions.

At these meetings, we discuss the measurements of pressures and temperatures of gases and liquids, the meaning and measurement of heat, the development of heat from fuel in a form that makes possible the production of useful energy, the process of converting liquid water to superheated steam, the passage of steam through a turbine, and in summary, a resume of the complete process of converting coal to electrical energy.

We devote one meeting to a discussion of the actual process of starting, operating and stopping a steam turbine-generator unit, complete with condensers and auxiliaries. We devote another meeting to the discussion of the important points to watch in connection with the operation of a steam generating unit. Throughout the series of meetings, wherever it fits in, we point out the loss of energy and the effect upon the efficiency of plant operation, indicating those losses that cannot be reduced and those losses that can be reduced by proper operation.

In the course of these meetings, it is pointed out that electrical service must be rendered on a continuous basis at constant frequency and at a proper voltage. These two characteristics must be provided at the plant. The load, on the other hand, is controlled entirely by the users of the energy.

The means of maintaining constant frequency leads to a discussion of operation at constant speed and the governors necessary to maintain constant speed. The discussion of methods of supplying proper voltage leads to the

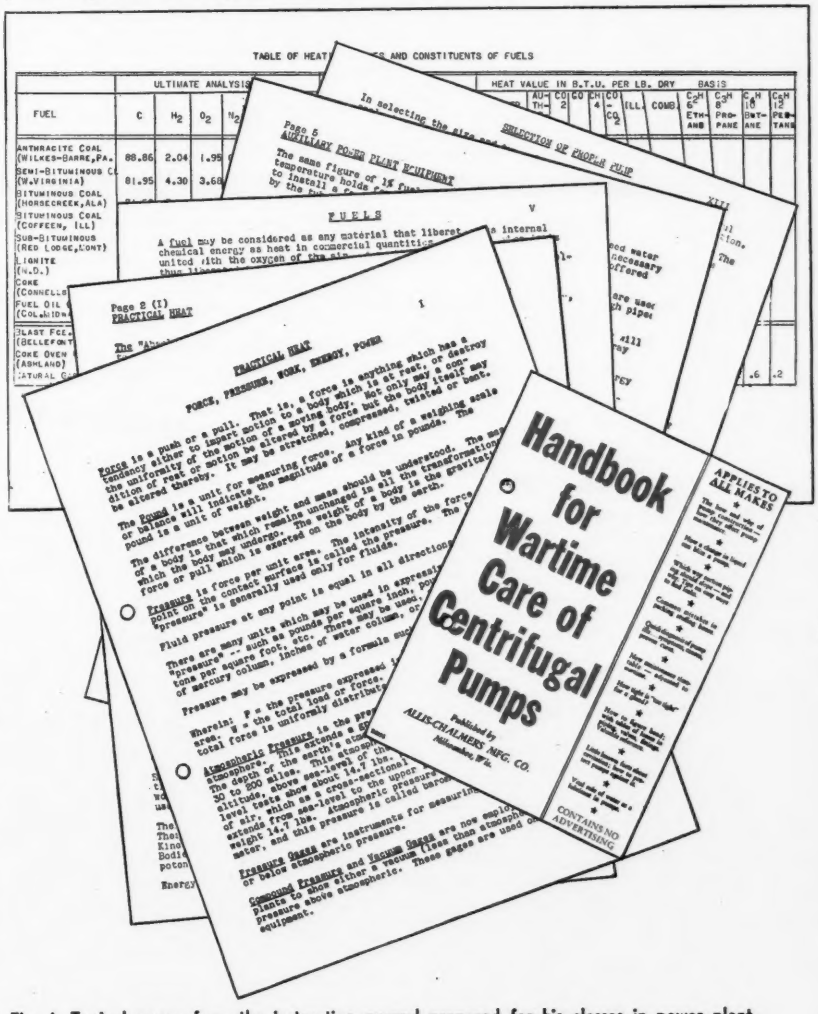
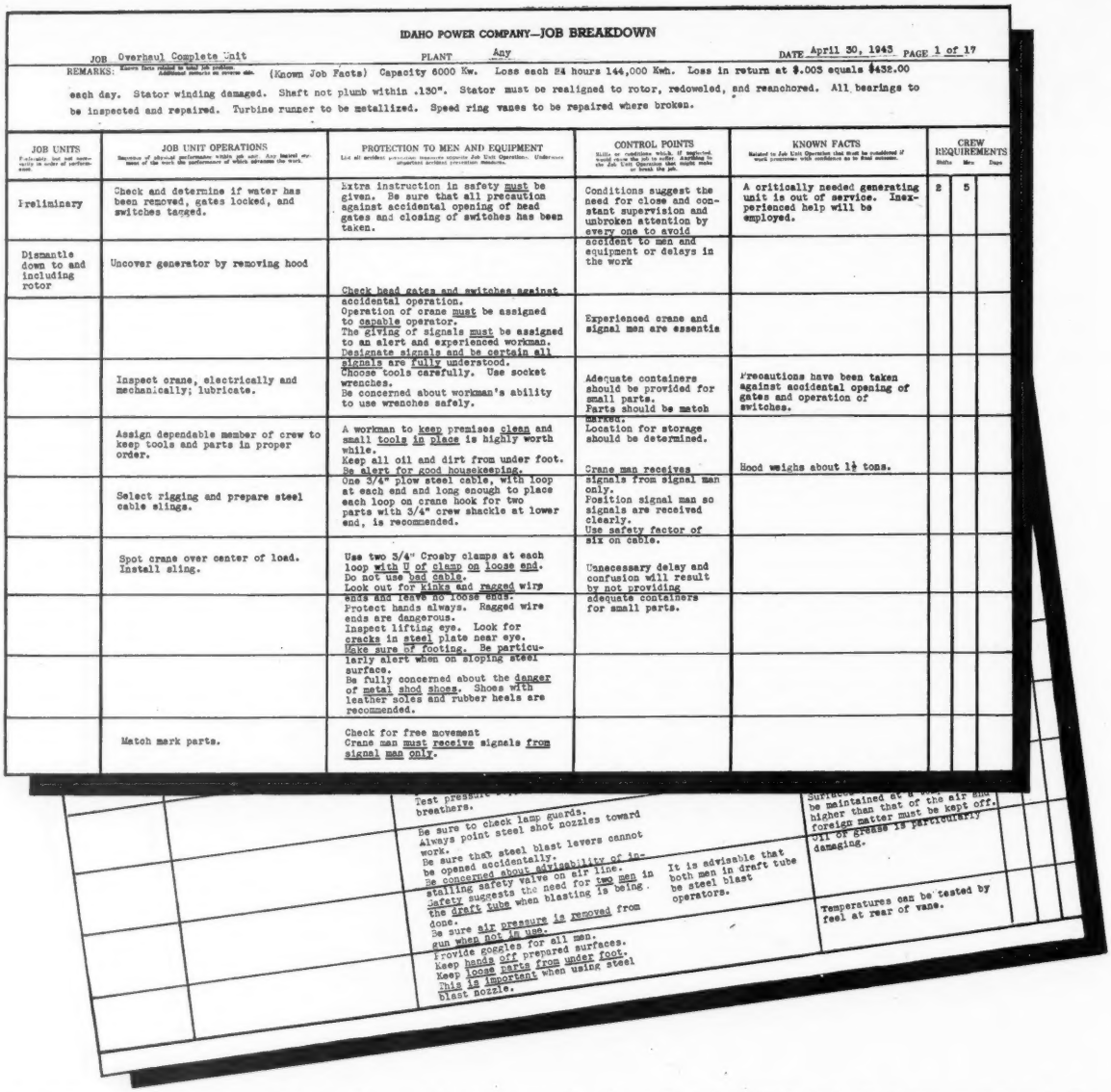


Fig. 1. Typical pages from the instruction manual prepared for his classes in power plant work by George M. Coughlin of American Rolling Mill Co., Ashland, Ky.

[2]Editor's Note—Mr. Coughlin has only 7 or 8 copies of his mimeographed lecture outline left but says he will gladly furnish what he has to any who desire them.



IDAHO POWER COMPANY—JOB BREAKDOWN

JOB Overhaul Complete Unit PLANT Any DATE April 30, 1943 PAGE 1 of 17

REMARKS: Known facts related to total job problem. Additional remarks on reverse side. (Known Job Facts) Capacity 6000 Kw. Loss each 24 hours 144,000 Kwh. Loss in return at $.003 equals $432.00 each day. Stator winding damaged. Shaft not plumb within .130". Stator must be realigned to rotor, redoweled, and reanchored. All bearings to be inspected and repaired. Turbine runner to be metallized. Speed ring vanes to be repaired where broken.

JOB UNITS Preferably but not necessarily in order of performance.	JOB UNIT OPERATIONS Sequence of physical performance within job unit. Any logical segment of the work the performance of which advances the work.	PROTECTION TO MEN AND EQUIPMENT List all accident prevention measures opposite Job Unit Operation. Underscore important accident prevention measures.	CONTROL POINTS Skills or conditions which, if neglected, would cause the job to suffer. Anything to the Job Unit Operation that might make or break the job.	KNOWN FACTS Related to Job Unit Operation that must be considered if work progresses with confidence as to final outcome.	CREW REQUIREMENTS Shifts	Men	Days
Preliminary	Check and determine if water has been removed, gates locked, and switches tanged.	Extra instruction in safety must be given. Be sure that all precaution against accidental opening of head gates and closing of switches has been taken.	Conditions suggest the need for close and constant supervision and unbroken attention by every one to avoid	A critically needed generating unit is out of service. Inexperienced help will be employed.	2	5	
Dismantle down to and including rotor	Uncover generator by removing hood	Check head gates and switches against	accident to men and equipment or delays in the work				
		accidental operation. Operation of crane must be assigned to capable operator. The giving of signals must be assigned to an alert and experienced workman. Designate signals and be certain all	Experienced crane and signal men are essentia				
	Inspect crane, electrically and mechanically; lubricate.	signals are fully understood. Choose tools carefully. Use socket wrenches. Be concerned about workman's ability to use wrenches safely.	Adequate containers should be provided for small parts. Parts should be match	Precautions have been taken against accidental opening of gates and operation of switches.			
	Assign dependable member of crew to keep tools and parts in proper order.	A workman to keep premises clean and small tools in place is highly worth while. Keep all oil and dirt from under foot. Be alert for good housekeeping.	marked. Location for storage should be determined. Crane man receives	Hood weighs about 1½ tons.			
	Select rigging and prepare steel cable slings.	One 3/4" plow steel cable, with loop at each end and long enough to place each loop on crane hook for two parts with 3/4" crew shackle at lower end, is recommended.	signals from signal man only. Position signal man so signals are received clearly. Use safety factor of				
	Spot crane over center of load. Install sling.	Use two 3/4" Crosby clamps at each loop with U of clamp on loose end. Do not use bad cable. Look out for kinks and ragged wire	six on cable. Unnecessary delay and confusion will result by not providing				
		ends and leave no loose ends. Protect hands always. Ragged wire ends are dangerous. Inspect lifting eye. Look for cracks in steel plate near eye. Make sure of footing. Be particularly alert when on sloping steel	adequate containers for small parts.				
		surface. Be fully concerned about the danger of metal shod shoes. Shoes with leather soles and rubber heels are recommended.					
	Match mark parts.	Check for free movement Crane man must receive signals from signal man only.					

Test pressure ... breathers.

Be sure to check lamp guards.
Always point steel shot nozzles toward work.
Be sure that steel blast levers cannot be opened accidentally.
Be concerned about advisability of installing safety valve on air line.
Safety suggests the need for two men in the draft tube when blasting is being done.
Be sure air pressure is removed from gun when not in use.
Provide goggles for all men.
Keep hands off prepared surfaces.
Keep loose parts from under foot.
This is important when using steel blast nozzle.

It is advisable that both men in draft tube be steel blast operators.

Supplied ... be maintained at a ... higher than that of the air and foreign matter must be kept off. Oil or grease is particularly damaging.

Temperatures can be tested by feel at rear of vane.

Fig. 2. Typical pages from a complete breakdown of the entire procedure for overhaul of a 6000-kv hydraulic turbine-generator unit. The complete breakdown is covered in 27 sheets, each 11x16 in. The explanatory notes above the various columns are: Job Units, preferably but not necessarily in order of performance. Job Unit Operations, Sequence of physical performance within job unit. Any logical segment of the work the performance of which advances the work. Protection to Men and Equipment, and all accident prevention measures opposite job unit operation. Underscore important measures. Control Points, skills or conditions which, if neglected would cause the job to suffer. Known Facts, related to Job Unit Operation that must be considered if work progresses with confidence as to final outcome. Crew Requirements, number of men, shifts and days

discussion of the excitation and voltage regulation. The carrying of varying loads as they occur leads to a discussion of the adjustments that must be made throughout the plant to vary the output, much of which is cared for by automatic control. In order to render the service on a continuous basis, we discuss the importance of careful operation and effective maintenance.

The topics enumerated above indicate the scope of the course and indicate that the classes must be skillfully guided by the instructor or class leader, so as to keep the discussion within the field to be covered and have it prove informative to new employees and interesting and enlightening to the older employees..

This series of meetings has usually inspired new employees to desire more specialized instruction, as a result of which they have enrolled in courses in combustion, steam engineering and related subjects on the basis that the company will pay one-half of the cost of the courses that are completed, and will advance the entire cash cost in order to assist the employee in getting started. If there are several enrollments at one time in one course, the company will form a class meeting regularly and provide instruction in the subject.

We have found that the employees appreciate such instruction and that it is of great aid in developing competent employees rapidly.

IDAHO POWER COMPANY
Boise, Idaho
E. A. WOODHEAD
Superintendent of Power Plants

RELATIVE to power plant job training, we have instituted an idea that we call "Job Breakdown." We see the need to be that of utilizing methods that permit us to make better use, if possible, of all the aptitudes, trade knowledge, and personality traits that are available now in the various plant crews. This we consider necessary so that vital facilities in the way of generating equipment shall be out of service no more than absolutely necessary and that time in connection with jobs be looked upon more than ever as being the essence of the problem. Also, ingenuity will be

used to its utmost if we make the best of the material situation.

This means that the main job problem will be properly divided into job units, wherein each unit can be looked upon as something separate, so that as much as possible of the whole problem will be carried on simultaneously. Job units will, therefore, be dovetailed and correlated in their proper relation to time, material, and energy.

Figure 2 shows page 1 and part of page 10 of a complete sample breakdown, which represents the first attempt of a certain plant maintenance mobile crew in breaking down one of their jobs.

The job unit operations, being always a physical performance of work, must be considered in all logical segments, the performance of which advances the work. Following job unit operations, protection to men and equipment is a very vital requirement. We must always take full advantage of all control points, skills or conditions which, if neglected, would cause the job to suffer. There are facts known to certain individuals of the group, and if they are not brought to the attention of the whole group, the job might be caused to suffer. And, finally, the job crew requirements in the form of man-days is given consideration.

Pacific Gas and Electric Co.
San Francisco, Calif.
A. C. Joy
Advertising Manager

UPGRADING of power plant operators is on a long established basis of seniority. As to the training of new and inexperienced men, we have a course of instruction, parts of an outline of which is shown on this page.

The company is using about 35 women in our San Francisco Bay region steam plants. They work as laboratory assistants, as helpers on water treating equipment and as helpers in boiler operation. Their employment in these capacities is considered generally satisfactory. They are outstanding in conscientiously applying themselves to their work. However, in certain work categories there have been found some physical limitations to what they can do, and readjustments have been necessary.

OUTLINE OF TRAINING PROGRAM
FOR NEW STEAM PLANT EMPLOYEES
PACIFIC GAS AND ELECTRIC COMPANY

I. GENERAL INSTRUCTIONS

A. Outline of Interview with General Foreman

1. Duties: The employee is given an outline of the duties of the job.
2. Learning the Work: It is explained that we have an established training program and only the cooperation of the employee is required for him to learn the job.
3. Safety First: The necessity of learning safe working methods is explained. The employee is instructed to ask questions of the men on the job and always to be sure he knows what he is doing before going ahead with his work.
4. General: The employee is given a short history of the plant and is told what wages he will receive, and is then turned over to the Plant Clerk.

The Plant Clerk instructs the employee how to make out time cards, informs him about pay periods, etc. and issues and demonstrates the use of gas mask. Employee is handed a copy of "Do It Safely," (Form No. 603312) and is instructed to read it over carefully, as he will be asked some questions pertaining to its contents at some future time. He is then introduced to his foreman.

The Johns Hopkins University
School of Engineeering
Baltimore, Md.
James H. Potter
Dep't of Mechanical Engineering

TRAINING COURSES having to do with the up-grading of power plant personnel have not as yet been undertaken. However, we have instituted four courses in marine engineering. These courses are intended to acquaint office and construction personnel with power machinery as it is used in a modern vessel, and to train test crews for new ships. Additional courses are also being offered in electrical engineering to train shipyard workers in the fundamentals of alternating-current and direct-current machinery and circuits.

II. TRAINING OF BOILER ROOM HELPERS (Pacific Gas & Electric Co.)

A. Burner Construction and Characteristics

1. Functions of Oil Burner.
   (a) Atomize oil.
   (b) Mix atomized oil intimately with air.
   (c) Feed oil and air into furnace in proper ratio and amount so that the heat liberated by combustion will supply efficiently the steam demand on the boiler.
2. Functions of Gas Burner.
   Same as above except no atomizing required.
3. Dismantle an oil burner completely, showing trainees the function of each part.
   (a) Show path of supply and return oil.
   (b) Show that it is the return oil pressure which forces oil into furnace through orifice in burner tip.
   (c) Show that excess of supply pressure over return pressure sets up the whirl of oil spray and creates effective atomizing.
   (d) From actual operating data, show that excess of supply pressure over return pressure is nearly constant, hence atomization is good over range of operation from full load down to 20 per cent load. Below 20 per cent may have to remove some burners from furnace to insure stable fires.

B. Operation of Gas and Oil Burners

1. Must keep oil burners clean to assure good atomization and good combustion.
   (a) Wash out with Oakite and compressed air on cleaning stand.
   (b) If burner does not clean up properly, lay aside for machinist to dismantle.
2. How to find dirty burners.
   (a) Electric eye smoke detectors show smoke.
   (b) Look into furnace through inspection doors above burners to find approximate location.
   (c) One person to watch through inspection doors while other tries turning off burners until smoking burners are found and replaced with clean ones.
3. Safety measures to be observed.
   (a) Always use blue glass and board, or mask, when looking through observation doors. Protect eyes and face.
   (b) Watch out for flarebacks from inspection doors while picking up load rapidly or transferring fans.
   (c) Women helpers should wear a hair covering to avoid possibility of hair catching fire.
   (d) Denim coveralls or jackets, with long sleeves, and medium heeled shoes without open work also necessary for safety.
   (e) Do not allow oil to accumulate on furnace floor. If burner dribbles oil, take it out of service.
   (f) Before putting an oil burner into service always look at atomizer to make sure that the tip is in place. If tip has been left out, large quantities of oil will be sprayed into the furnace without being atomized. This is dangerous.
   (g) Be careful in handling burners not to damage tips. They are made of very hard brittle metal. If chipped, they are no good for further service.
   (h) Be sure that air registers are open when a burner is lighted.
   (i) In removing oil burners, have drip cup in place and be sure valves are closed before loosening clamp.
   (j) Be sure copper gaskets are in place before clamping a burner and turning on oil. Failure to do so may result in a spray of hot oil striking you.

Illinois Institute of Technology
Chicago
J. I. Yellott
Chairman War Training Committee

WE HAVE had no calls from the local industries for cooperation in training power plant men, consequently we have not included any material on the steam power plant, other than one early course, in our War Training Program. We have had no calls for women for training in this field.

Now, however, and primarily because you started us thinking about this matter, we are going to offer an ESMWT course in Steam Power Plants in our fall program, which will get under way on October 4.

The course will be an intensely practical one, aimed to teach men who are high school graduates the theory behind the operations of the power plant, so that they will be able to learn their operation more quickly and take responsible positions at an earlier time.

Michigan Sugar Company
Saginaw, Mich.
W. L. Chapman
Executive Engineer

WE HAVE MADE no special arrangements for a wartime training program of our power plant personnel and do not use women in any of our power plants. Some women are being used for packing sugar and in this coming campaign we expect to use them on some of the stations throughout our plant, such as on the carbonation and evaporator stations. We did not do this last campaign and had considerable difficulty keeping a full crew for operating.

In the past we have had a regular scheduled series of classes for our maintenance and power plant crews, but this was not a wartime measure in any sense of the word. However, if it will help anybody in planning a training program, the following applies to what we did in 1940 and 1941.

All plant operations start about the 1st of October and continue through until about the first of the year. Dur-

ing this period we operate seven days a week and 24 hr a day and for the rest of the year carry a crew consisting of our key men on the various operating stations as well as our maintenance crew. During the idle period we set up our program for reconditioning the entire plant and, therefore, can quite readily arrange for meetings for instructions during this idle period without interference with our regular operations.

A manual, parts of which are shown in Fig. 3, covers principally the work we covered for our plant engineers and mechanics, in which we have endeavored to acquaint them with technical terms in such a way that they are understandable to men without college training.

The first year's program worked out fairly well, although most of the discussion was carried by the trained engineers and men from equipment manufacturers. The following year we sent out lists to all the men interested and had them make their selection of topics for the various meetings and these meetings were turned over to the men to a greater extent. The discussions were of more practical nature and more interest was evolved by having each plant handle one meeting with papers on one or two sections of the topics involved. This we found created a great deal of interest among the men and brought forth many valuable exchanges of practical information between our various plants.

In 1942 we began to feel the labor shortage and consequently were able to hold only three meetings that year and this year have been unable to work in any of them.

We have found such meetings beneficial not only in the distribution of information to our men, but also in obtaining valuable suggestions from them, both at the meetings and during the regular course of our work.

PORTLAND GENERAL ELECTRIC COMPANY
Portland, Oregon
C. P. OSBORNE
General Superintendent

EARLY IN 1940, the Northwestern Electric Company, an electric public utility company with headquarters and service here in Portland, and our company joined with Local Union B125 of the International Brotherhood of Electrical Workers for the purpose of establishing, under the provisions of the State Apprenticeship Act, an apprenticeship program in the five following major branches of the outside electrical workers' trade, namely:

a. Line construction and line maintenance.
b. Station construction and station maintenance.
c. Station operation.
d. Meter installation and meter maintenance.
e. Appliance maintenance (customers' water heaters and ranges).

Under the provisions of this Act, the two companies and the local union appointed representatives to sit on an apprenticeship subcouncil composed of a total of four representatives from the two companies and four representatives from the Local Union. This subcouncil, now known as the Outside Electrical Workers' Apprenticeship Subcouncil for the Portland area,

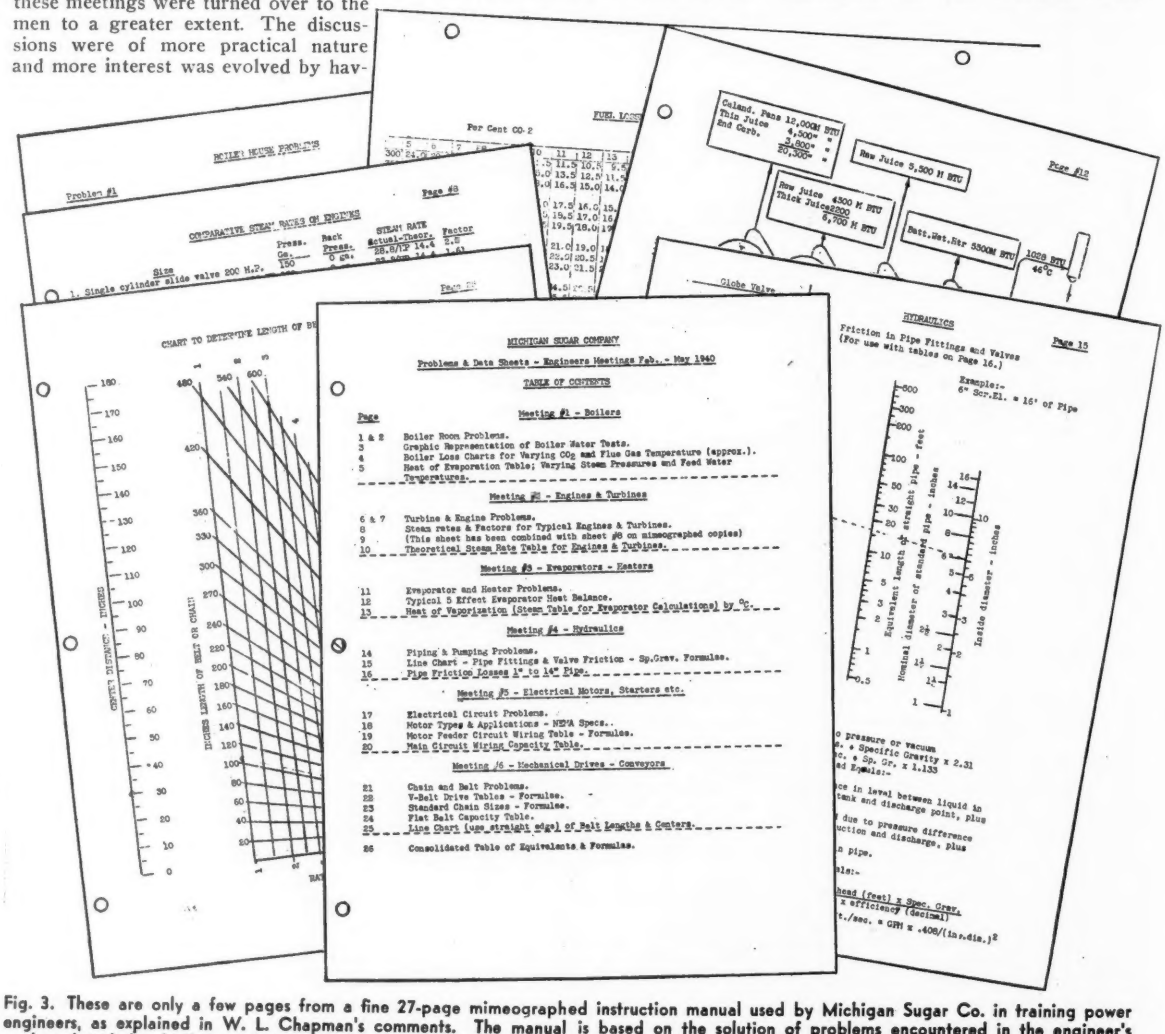

MICHIGAN SUGAR COMPANY
Problems & Data Sheets - Engineers Meetings Feb. - May 1940
TABLE OF CONTENTS
Meeting #1 - Boilers
Meeting #2 - Engines & Turbines
Meeting #3 - Evaporators - Heaters
Meeting #4 - Hydraulics
Meeting #5 - Electrical Motors, Starters etc.
Meeting #6 - Mechanical Drives - Conveyors
HYDRAULICS
Friction in Pipe Fittings and Valves
CHART TO DETERMINE LENGTH OF BE

Fig. 3. These are only a few pages from a fine 27-page mimeographed instruction manual used by Michigan Sugar Co. in training power engineers, as explained in W. L. Chapman's comments. The manual is based on the solution of problems encountered in the engineer's work and includes fundamental data such as steam tables, steam rates of engines and turbines, pipe friction data, tables of motor characteristics, wiring data, V-belt and chain drive and flat belt tables, convenient formulas and at the end, the answers to the problems

worked out the details of the apprenticeship program and now guides its operation.

The program is effected by means of a voluntary written agreement between the company in question and its apprentices and sets forth those matters which are implied at the time the apprentice goes to work such as the phases of the particular branch of the trade which he is to learn, the wages which he is to be paid, his trade standing in terms of per cent of journeymanship rating at the time of entering upon the agreement and a probationary period of 500 working hours, as well as a requirement that he, the apprentice, attend classes dealing with the related subject matter of his particular branch of the trade for at least 144 hr per year.

In this connection, the Portland Public Schools joined with us in this venture by offering classes dealing with the subject matter relating to the tools, materials, equipment, electrical theory, mathematics, economics, history, drawing, personal accident prevention, personal hygiene, property damage, including the work of others, information relating to other trades and rules and regulations governing the operation and use of electrical circuits and equipment.

It should be made clear at this point that the apprentice's advancement in the trade is dependent upon his application to the work on the job as well as his work in classes, because both are an essential part of learning a trade and, therefore, are taken into consideration by the Subcouncil when making recommendation for advancement.

From this outline it can be seen that a very definite training program has been worked out for the apprentices and is just getting under way, as is evidenced by the fact that the details of the program have just been put into tentative printed form, a copy of which is enclosed herewith. Typical pages from this program are shown in Fig. 4.

It has become increasingly difficult to make this program function as it should because of the influence of the war. However, it is expected that it will come into its own when the war is over. We, in our company, heartily support it for the reason that it does the job that needs to be done, namely, that of developing more careful and more efficient workmen, with the net result that the public gets a more dependable service.

Referring to your second question, we are not using women in our power plants.

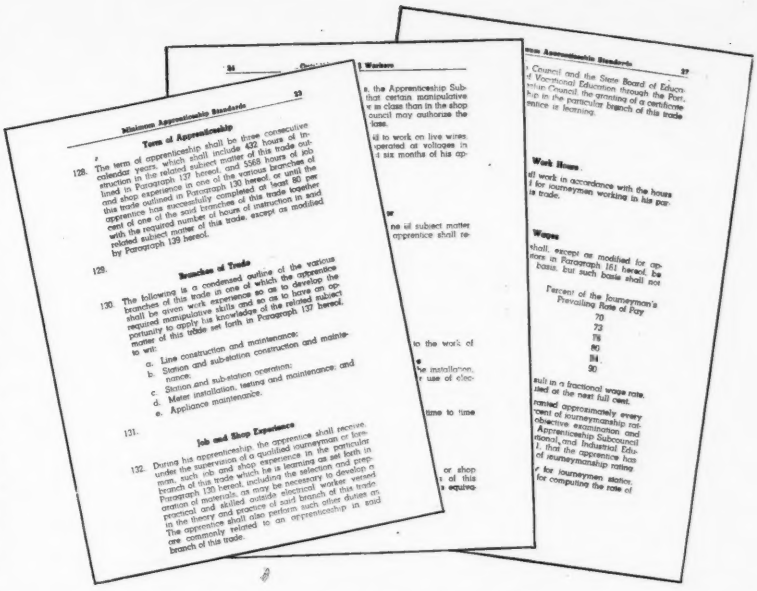
Puget Sound Power & Light Company

Seattle, Wash.

C. W. Sherman

Asst. Personnel Officer

BECAUSE our company is situated in the very heart of a vital war production area, we realized that the manpower problems would greatly affect us. To properly train replacements for power plant operators, we established a training course under a full time instructor. The academic portion of this course was held in a classroom in our Shuffleton Steam Plant on Lake Washington.



Minimum Apprenticeship Standards

Terms of Apprenticeship

128. The term of apprenticeship shall be three consecutive calendar years, related subject matter of this trade construction in the related subject matter of this trade combined in Paragraph 137 hereof, and 5568 hours of job and shop experience in one of the various branches of this trade outlined in Paragraph 130 hereof, or until the apprentice has successfully completed at least 80 per cent of one of the said branches of instruction in said with the required number of hours of this trade together related subject matter of this trade, except as modified by Paragraph 129 hereof.

129.

Branches of Trade

130. The following is a condensed outline of the various branches of this trade in one of which the apprentice shall be given work experience so as to develop the required manipulative skills and so as to have an opportunity to apply his knowledge of the related subject matter of this trade set forth in Paragraph 137 hereof.

a. Line construction and maintenance;
b. Station and sub-station operation;
c. Station and sub-station construction and maintenance;
d. Meter installation, testing and maintenance; and
e. Appliance maintenance.

131.

Job and Shop Experience

132. During his apprenticeship, the apprentice shall receive, under the supervision of a qualified journeyman or foreman, such job and shop experience in the particular branch of this trade which he is learning as set forth in Paragraph 130 hereof, including the selection and preparation of materials, as may be necessary to develop a practical and skilled outside electrical worker versed in the theory and practice of said branch of this trade. The apprentice shall also perform such other duties as are commonly related to an apprenticeship in said branch of this trade.

Work Hours

all work in accordance with the hours for journeymen working in his particular trade.

Wages

shall, except as modified for apprentices in Paragraph 161 hereof, be on a basis, but such basis shall not

Percent of the Journeyman's Prevailing Rate of Pay
70
72
78
86
94
90

result in a fractional wage rate, stated at the next full cent.

Journeymanship Rating

Journeymanship rating shall be determined approximately every six months of the apprentice's employment by objective examination and rating by the Joint Apprenticeship Subcouncil, and Industrial Education Council, that the apprentice has attained the journeymanship rating.

Schedule for Journeymen Status

The following schedule for computing the rate of

Fig. 4. A few of the sections from the Plan of Apprenticeship worked out by Portland General Electric Co., Northwestern Electric Co. and the International Brotherhood of Electrical Workers

This course consists of three weeks of general instruction in electrical, mechanical and steam fundamentals, followed by a two weeks' assignment during which the trainees are given the opportunity of actually working on various jobs to determine their particular aptitudes. Upon completion of this two-week assignment, they return to the classroom for further instruction along specialized lines. Those whose desires and aptitudes point to plant operation specialize in this branch. Others who are more adapted to electrical or mechanical maintenance receive specialized training along these lines and those whose background and aptitudes fit them to become steam operators receive specialized training in steam operation.

Upon completion of the academic portion of the training course, the trainees receive practical assignments covering a period of five weeks in the case of electrical operators and electrical maintenance men, and six weeks for steam operators and mechanical maintenance trainees. Upon completion of the entire training course, the trainees are assigned to the various plants and substations as needed.

In addition to the above training course, our company has adopted the Job Instructor Training Program of the Training Within Industry Division of the War Manpower Commission*. To date we have some 524 certified Job Instructors throughout our organization.

To date we have used women in power plants in the capacity of operating clerks and operating record clerks.

Sample pages from our training manual on Auxiliary Machinery and Trainee Questions are shown in Fig. 5.

*Details of the Job Instructor Training Program are given on Page 71.

The Youngstown Sheet and Tube Company

Youngstown, Ohio

J. H. Krehl

Asst. to Gen'l Supt.

FOLLOWING is a brief description of an elementary course to prepare employees to obtain Ohio Boiler Operator's and Stationary Engineer's licenses.

The course was instituted primarily because the demand for licensed men exceeded the normal supply and the Selective Service Act was depleting the ranks. Also, in view of the prevalent labor unrest, it was felt that a more intimate contact with the operatives, at negligible cost to them and possible betterment of their positions, might create a more favorable attitude.

The course was expected to be completed in ten meetings of two to two and one-half hr each; actually, thirteen meetings were held, one meeting each week for each of two groups of men. No manual was prepared and no textbook was specified as compulsory; however, it was recommended that some reference book be available to each student. Because of the low cost, number of copies in the community and range of equipment discussed, Bailey's Handbook, Questions and Answers for Engineers, was suggested as acceptable for reference.

A total of 464 questions were compiled in nine sets, ranging from 29 to

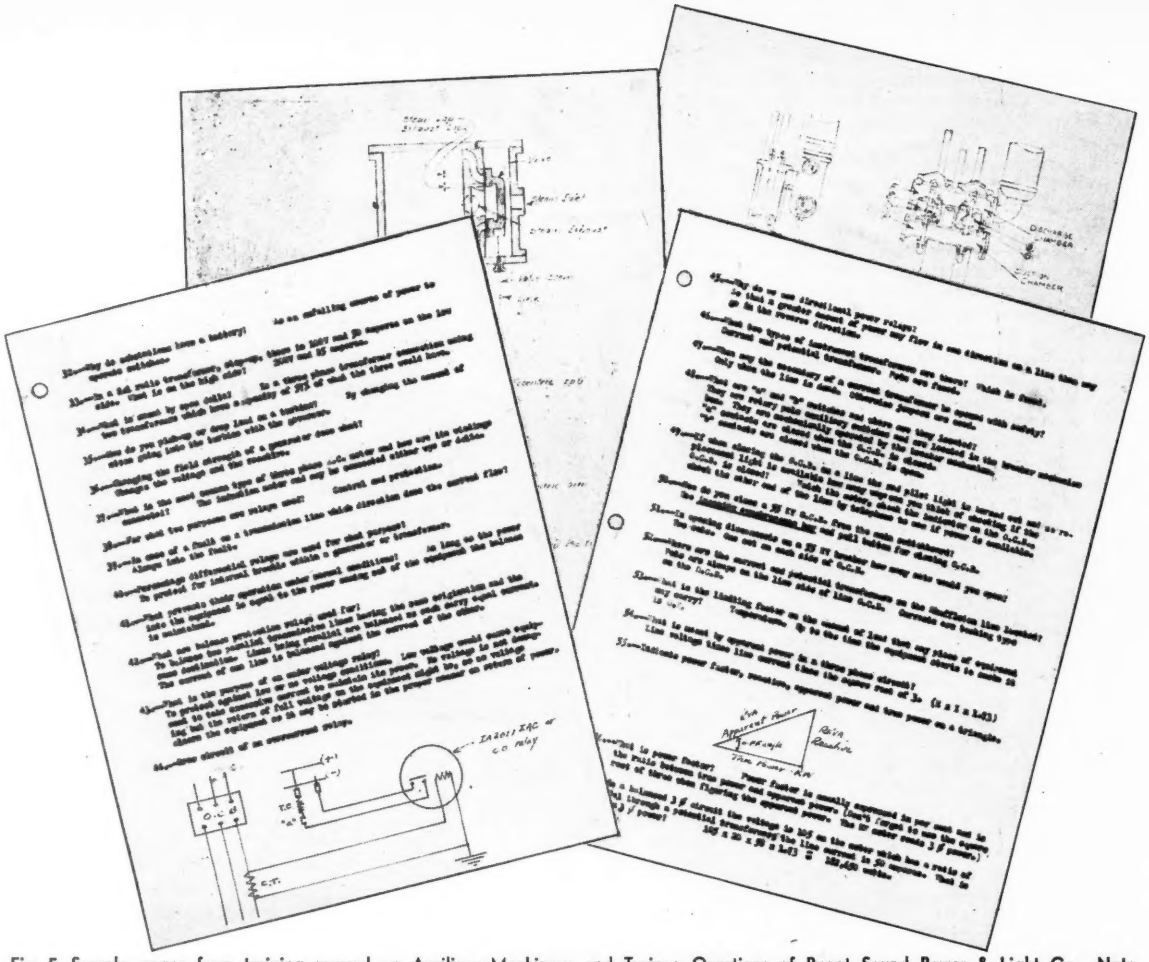


Fig. 5. Sample pages from training manual on Auxiliary Machinery and Trainee Questions of Puget Sound Power & Light Co. Note the short, practical questions and answers and the use of sketches, all referring to specific plant details and designed to show the trainee operating procedures as well as fundamental principles

117 questions per set. One set of questions was issued per meeting during nine meetings. The questions were discussed in detail at meeting issued, covering as much theory as possible and practicable. The students were required to insert the answers to the questions before the next meeting, assisted by previous classroom discussion and reference books. The answers were reviewed in a subsequent meeting. A number of typical questions are shown in the accompanying table.

It was announced, initially, that their final examination would be given by the State Examiner, if and when they applied for an Operator's License. The course was not compulsory; the students attended the meetings on their own time and furnished their transportation. It was not considered desirable to make the course obligatory or to conduct it on company time.

Considerable interest was in evidence so long as the discussions were not too theoretical. Many of the students were eligible for armed service and some were inducted before the course was completed. In this respect, we do not consider the efforts ultimately wasted, because we expect many of these boys to return to us subsequently. Many cases of long hours on duty, because of the manpower shortage, handicapped attendance, as also did the gasoline restrictions.

Typical questions from the nine sets of questions answered and discussed in classes for power plant operators conducted by Youngstown Sheet & Tube Co. to prepare employees for Ohio Boiler Operator's and Stationary Engineer's Licenses

Insert answers before March 1 and 5, 1943.

10. What kind and minimum number of valves in feed line for two or more boilers connected to the same feed-water main?
11. Tell relative position of different valves in No. 10.
12. How many means required to supply feedwater to 500 sq ft heating surface or larger boiler?
27. How may boilers allowed different maximum pressure be connected to a common steam main?
28. How many and what kind of valves must be used in blow-off line for stationary boiler?

Insert answers before March 8 and 12, 1943.

9. How many btu per pound of water (a) to melt ice from and at 32 F?; (b) to raise temperature from 32 to 212 F?; (c) to vaporize from and at 212 F?; (d) what is total heat of steam?
14. What is meant by critical steam pressure?
16. What is entropy?; (b) What is enthalpy?
17. What is isothermal expansion?

Insert answers before March 15 and 19, 1943.

1. What precautions advised in blowing down a boiler in operation?
2. If boiler primes, (a) What is probable cause?; (b) How stop it immediately?
6. (a) What adjustment to change blowback of safety valve?; (b) What meant by blowback?; (c) What is usual percentage of blowback?
13. If four boilers in battery and inspector cuts pressure on two of them, what changes make in setting of safety valves?
15. What effect will leaky baffles have in a water-tube boiler setting?
29. What would you do if your safety valve stuck, steam gage read 40 lb above popping pressure?

Purdue University
Office of War Training
in
Engineering, Science, Management
Lafayette, Indiana

C. W. Beese
Director

COOPERATING with the U. S. Office of Education, Purdue University has participated in the Federally-financed, college-level training programs for the past three years. Last year nearly 22,000

persons were enrolled in 846 Engineering, Science, Management War Training classes. Employees of almost 1000 Indiana companies producing goods for the war effort have been benefited by this training.

Three Power Plant courses, "Elementary Heat Engineering for Steam Power Plants," "Steam Power Plant Equipment" and "Power Plant Testing" were requested by Indiana Industries and have been made available through this program during the past year. Topical outlines are shown in Fig. 6. Note that these courses, like most of our War Training courses, are 72 hours in length. Classes meet 3 hr an evening, 3 evenings a week for 12 weeks. Engineers from industry are selected by a resident staff committee and paid to teach the classes. Because of the educational background and the experience required by the power plant courses, very few women meet the prerequisites or need the training. To date none of the persons enrolling in these power plant courses have been women, however, future needs may make it necessary to recruit women.

Another course which is available but was not requested during the past year is "Boiler Feed Water Conditioning."

Our Field Organization has found that there is a need for a course in Boiler Plant Engineering. This course is designed to up-grade persons familiar with boiler plant operation to supervisory positions.

Job Instructor Training Program of the War Manpower Commission

NOW THE SKILLED workman is essentially a doer, not an instructor. Sometimes he is lucky enough to have both talents. But to help these skilled workers and supervisors learn the knack of passing their skill on to others, the Training Within Industry Division of the War Manpower Commission developed a short practical program of Job Instruction Training, now known generally as J.I.T. C. R. Dooley, Director, Training Within Industry, War Manpower Commission, Washington, D. C., has made available considerable information summarized below, on this program. Local and regional WMC offices have plenty of additional details if required.

Good power engineers, it is true, possess higher than average instructing ability. Yet even in the power field, as evidenced by many of the foregoing statements, it has been necessary for many companies to supplement the learner's on-the-job experience under supervision with more formal classwork and education.

By short practical demonstrations to groups of not more than 12 people, the supervisors are shown how to instruct properly. Very briefly, four basic steps in preparing to instruct will save time later, prevent confusion and save materials. They are: 1. Have a timetable. 2. Break down the job. (See Idaho Power Company statement for an excellent example of the job breakdown.) 3. Have everything ready. 4. Have the work place properly arranged.

After these four steps are taken, the supervisor is only ready to instruct the learner.

The above, very briefly, sketches the general outline of the J.I.T. program and its application. Those interested can get full details through the Training Within Industry Division, WMC.

Selection, Training, and Up-grading of Operators

By Bill Maddock, M.E.

IF STABILITY of employment is to be desired, selection simmers down to two major considerations:

1. Fitness of the man for the job;
2. Fitness of the job for the man.

Management has been too prone to consider only the first item, or the fitness of the man. In trying to get the best possible man for the job, they have often overlooked the fact that the man might be too good for the job. Unless the position is used by management as a feeler or stepping stone, the turn-over will be terrific if the position and man are not matched.

Management cannot be blamed altogether, because the only way that they

(*Continued on Page* 110)

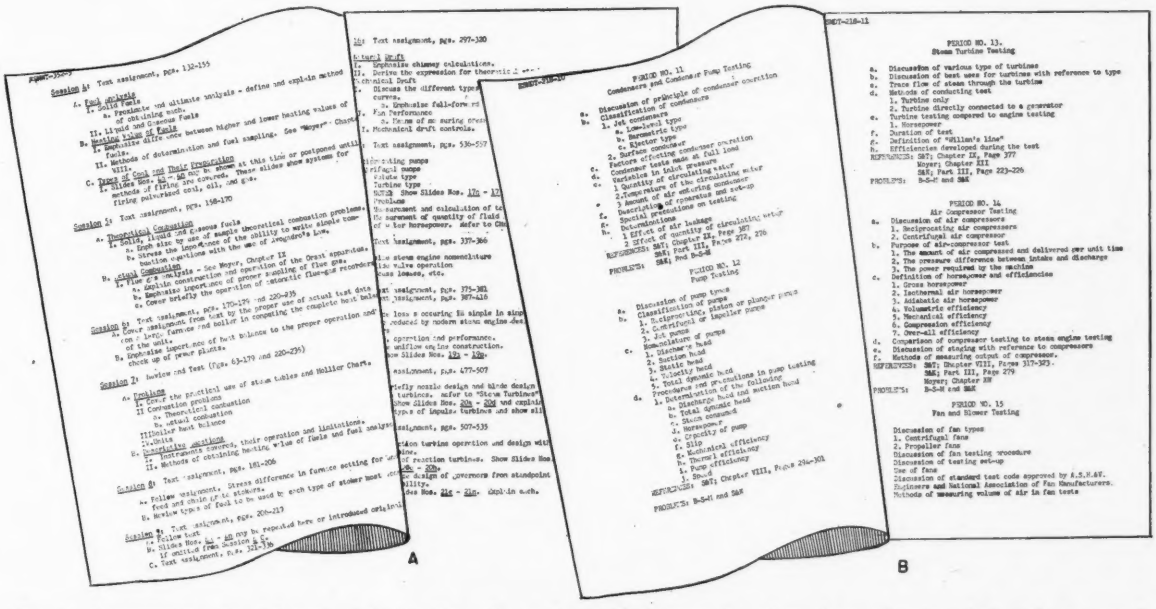


Fig. 6. Accompanying the statement of Purdue University on its ESMWT courses in various phases of power plant work are several extremely interesting and detailed mimeographed outlines of the various courses, which could doubtless be obtained by anyone establishing training courses. To any engineer who must teach such a course they would give invaluable help, for they show him what points to emphasize and give references to authoritative texts on the various points. At A are shown two typical facing pages of the outline for the course in Steam Power Plant Equipment. A tabulation, not shown, gives text references for both assignments and topics covered. The text used was Elementary Steam Power Engineering by MacNaughton (John Wiley & Sons, N. Y., $5.00). Each student was also expected to purchase a Keenan & Keyes Steam Tables (Wiley, $2.75), and have notebook and slide rule. Other standard texts for reference, lantern slides, models, technical magazines and other aids were available. At B are shown two typical pages from the outline for the course in Power Plant Testing, organized much like the other. There was no single text but reference books such as Shoop & Tuve, Moyer, Diederichs and Andrae, Severns & Degler, Gebhardt, Marks Handbook and technical magazines—Mechanical Engineering, Power Plant Engineering and Power—were used. A course outline for instructors, not shown here, was submitted covering Elementary Heat Engineering for Power Plants, another for Boiler Feed Water Conditioning and a third for Boiler Plant Engineering. Courses were conducted by combinations of lectures, question periods, discussion periods, problems and demonstrations.

SISTERS

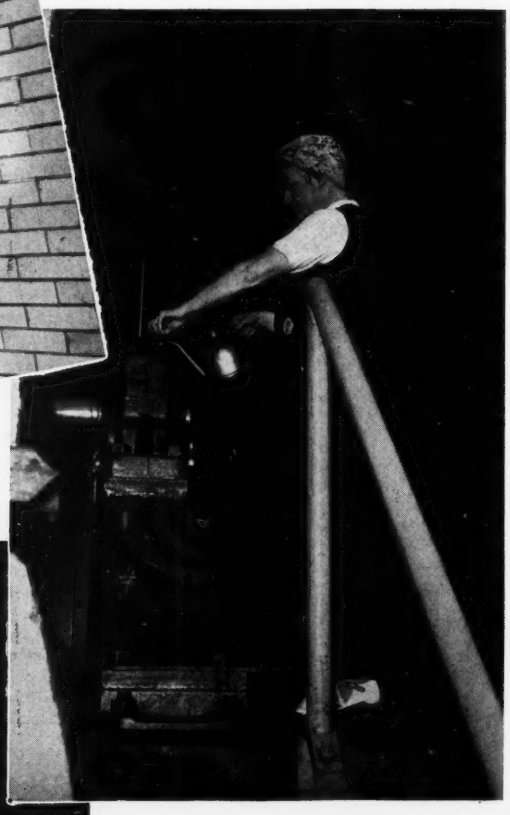


Fig. 1 (Upper left). A woman, acting as a turbine auxiliary operator taking hourly readings at a turbine auxiliary control panel in one of the stations of the Buffalo, Niagara & Eastern Power Corp.

Fig. 2 (Above). An auxiliary boiler operator doing oiling at an induced draft fan in one of the stations of the Buffalo, Niagara & Eastern Power Corp.

Fig. 3 (Left). Mrs. Elizabeth Shull wields a full scoop and a professional one in the boiler room of one of the Pennsylvania Roundhouses

WOMEN are not new to industry. From the beginning of the mechanical revolution, women have been employed in large numbers in factories of all types and description. Until recently women have not been employed in power plants except as clerical workers in the largest central stations. In the present situation, however, women are coming into use in power plants not only as operators and technicians but as machinists, repairmen and janitors. As in other fields, women have proved adaptable and generally satisfactory for this work and there is every reason to expect that their number will grow. In some quarters there is considerable resistance to their employment and where they are employed there is often reluctance to have the fact known. Just why this is so can probably be explained best by the average male's inverted sense of superiority over the so-called weaker sex. Some men do not view the possibility of more women employees in power plants with any degree of happiness, indeed they seem quite uneasy about it.

The fact remains, however, that in the comparatively few cases where women are being employed in power plants they seem to be working out satisfactorily. In the company statements on this question presented on other pages of this issue will be found very little criticism and in most cases, favorable comment. As one reply to our questionnaire put it, "some of us will be surprised at the good job they (women) will do and we,

OF THE STEAM GAGE

probably, will be glad to get them."

The railroads have demonstrated that women can be employed to do work that most of us would have thought far too strenuous or dirty. They are working in every capacity from dispatchers and train conductors to boilermaker's helpers, engine cleaners and track maintenance workers. Look at Mrs. Elizabeth Shull in Fig. 3 whose work it is to keep the fires burning under the roundhouse boilers of the Pennsylvania system. She is not large but she handles the scoop with the hand of an expert and she looks anything but unhappy. She is doing a man's job and she seems proud of it, and well she might be.

of the recording instruments on the big turbine control board went out of whack, one of the girls calmly opened it up, took out part of the works and after tinkering around with it for a few minutes put the instrument back in place and placed it back in operation.

What will happen to the women when this period of emergency has passed remains to be seen. The only certainty at the moment is their willingness to assume the arduous duties of their male compeers who have gone to battle and their unquestioned ambition to do the best possible job safely and efficiently. They have shown themselves to be adaptable, versatile and conscientious.

Fig. 4 (Above). This young woman seems to know how to clean condenser tubes

Fig. 5 (Right). Girl power plant clerk at the Jacob Rupert Brewery power plant changing recorder chart

A job more to our liking for a woman is that of the young lady shown in Fig. 1. She is one of a number of young women employed in large central power stations as turbine and boiler control board operators and attendants. They do more than merely take hourly readings of the instrument. In one large station we visited recently, women attendants had charge of the very largest steam turbines. They were quite at ease, went about their duties with the assurance of old timers and seemed alive to their responsibilities. When one

The Ladies of The Black Gang

"Where are the happy days gone by
When Woman's maximum ambition
Was cooking chow and raising kids
While hubby worked (or went a-fishin')?

Those happy days when men held sway
In industry, are gone, alack! ——
("Alack," sez you! Well, tell me then,
Why one should really want them back!)

You go into the Turbine Room
Where things should run without a hitch;
When circuit breakers slam ajar,
It's "Hi, there, Polly, pull the switch!"

In Boiler Room, where, heretofore,
A man might strip to union suit,
You now must be on dress parade
For Susie's back there blowing soot.

Don't look! But, tripping down the steps
So spry, now, what do you think of that! ——
A buxom Miss in over-alls, ——
It's Olive with her big Orsat!

While Gracie with her goggles on
Inspects the bright interior,
To check the slag upon the walls ——
(I'll say, she's not inferior).

Now judging by the traffic jam
Of salesmen who each other chase,
'Tis well to have the ladies round,
They seem to brighten up the place!"

Editor's Note: This poem was written by one of the field engineers of the Bailey Meter Co. after visiting the power plant of the Scott Paper Co. at Chester, Pa.

Company Statements on Training of Operators

Most of the companies whose comments are given below have not been seriously handicapped or crippled, so far, by manpower shortages in the power plant operating staff. Most of the key operators are over the draft age, their jobs are essential to the war, few succumb to the lure of "higher wages" in new war industries. If the draft takes some of the younger men or they volunteer, replacements from below or from other departments are possible. Often the only difficulty has been in obtaining common labor. Company educational courses, night school courses and the like have sometimes helped speed up training. On the whole, the basic power plant procedure of putting less experienced men—and women—in with the older hands for training and supervision, has been followed thus far.

Consolidated Gas Electric Light and Power Company of Baltimore
Baltimore-3, Md.

Being in a labor shortage area and having need for an increased number of power plant operators due to increases in plant capacity and to higher use factors, it has been necessary for us to advance less experienced men as rapidly as possible and to take on a number of new men.

Many of the latter were transferred from other departments in the company where activities have been curtailed on account of the war. The remainder were for the most part obtained in the open market, some having been supplied by the USES.

As the majority of these additional men were not so well educated, were unfamiliar with shift work and, in many instances, were older, the problem of training them has presented many difficulties and has required much greater effort, with attending poorer results, on the part of supervisors and older and experienced employees.

I am hopeful that it will not be necessary for us to use women in power plants, as I am not at all happy about the possible outcome.

A. L. Penniman, Jr.

City of Fort Wayne, Ind.

The method used in training generating station operators is the same as has been used in the past. Some of the training received by prospective operators has been shortened and not as thorough as would be given in normal times. However, it was felt that the known method of training operators should be used rather than a new program hurriedly thrown together.

The City Utilities is extremely small, therefore, has very few operating men to train. Thus, it is not feasible to set up a definite training course for the training of these operators. Rather, we conduct training whenever necessary on a personal basis; that is, a new operator is taken in hand by a supervisor inside the plant. He is shown the various equipment and given a rough outline of the method of operation. His duties are explained to him and the material used is the schematic wiring or piping diagrams of the Plant.

We have found that the most effective device for training these new operators is to have them make as many of the operations as possible, with the supervisor watching for mistakes, but offering no comments until after the operation is completed. While this training is in process, the man is working a regular shift with an experienced operator and, of course, picks up many practical points in this manner.

The more difficult job is to keep the experienced operators in practice. After they have become thoroughly familiar with the operating job, it frequently happens that they make very foolish mistakes, which it seems should be very well known. But under present day conditions, particularly in a small utility, operating emergencies occur only at very long intervals. It is just the lack of practice that causes these operating mistakes to be made.

W. Kehoe,
Chief Engineer

Iowa Electric Light & Power Company
Cedar Rapids, Iowa

Our men, in the majority and in the more responsible positions in our power plants, have been with us for many years. Consequently, we have been very little affected by the draft, and most of our men have had no desire to leave the employment of the company to go to work for some of the so-called "war babies." Our rates of pay are rather attractive, and our most serious difficulty lies in the common labor situation, which is common to all.

John M. Drabelle,
Consulting Engineer

Pennsylvania Sugar Company
Philadelphia, Pa.

We have been making boiler operators by picking the best possible ashmen and then letting Nature take her course. It takes a long time, but so far the older men at the top of the ladder have not left too fast for this procedure. The war industries have taken some and good old St. Peter has called some, but the process has not overwhelmed us.

We have one woman in the boiler house. She is the water chemist. Her duty is to check the work of the three water softener operators and to make occasional coal analyses.

I called up the Bureau of Boiler Inspection and learned that a fireman's license was issued to a woman eight yr ago. She was stoking a hand-fired boiler and doing a good job. She is large of frame and answers to a name of Polish extraction.

I am told that the Pennsylvania Railroad employs two women brakemen on Delaware Ave. near Reed St. One is a blonde and the other a brunette. No other qualifications are mentioned, but I would assume that to be qualification enough!

Dan Gutleben

Nebraska Power Company
Omaha, Nebraska

In past years—that is, before the war—we maintained a school for power plant operators, which ran for 33 weeks each winter. However, during the past year our personnel has been changing so rapidly due to war conditions that we have given up the school method entirely. Our training of new and inexperienced men is now left in the hands of the supervisor or shift foreman with whom the new men are placed.

As yet we have not had to employ women in either of our power plants, but cannot say how soon this may have to come.

After the war we hope to return again to the school method, but at present are simply trying to get along.

C. F. Turner,
Asst. Supt. Power Stations

An Eastern Public Utility

I have heard a great many discussions by power plant operators on the subject of using women and inexperienced men in power plants. It seems to me that most of us have too much fear that this cannot be done, that men to work in power plants must be somewhat in the class of supermen, and that ordinary persons just don't take to this work. Perhaps I am wrong, but I have no fear that women and inexperienced men will be used, that we will be glad to get them, and that some of us will be surprised at the good job they will do.

Of course, they will need some training and undoubtedly will not be as versatile as men who have worked in plants for a number of years. I am sure that a boy off the farm who drives a tractor, a truck, or an automobile, who repairs everything from the roof of a house to the treads on the tractor and who works 12 to 24 hr a day will develop, in a very short time, to a good man around a power plant. Of course, we won't try to put them into the highly skilled jobs and probably won't need to because in general these are held by men who are too old to be in the army.

As for the women, we now have more than thirty of them who are all working on unskilled jobs. They are working out well and I am sure some of them will work into the lower-grade operating jobs without any difficulty. The biggest problem I see with the women is: What is going to happen to them when the War is over?

GENERAL SUPT. OF POWER STATIONS

THE PENN MUTUAL LIFE INSURANCE COMPANY
PHILADELPHIA, PA.

WE HAVE, when possible, promoted men we thought were qualified from porter or other positions to the position of fireman trainee. These men are given two weeks under the first operating engineer, who gives them a broad picture of power plant operation. During these first two weeks they are carefully trained in the safety rules of the plant. We try to impress upon them that in power plant operation, an operator never takes a chance. He either knows or he doesn't know and if he doesn't know, he asks. This is true of everyone, irrespective of experience or number of years of service.

After this two weeks' training period, if the man still qualifies, he is placed under the supervision of a fireman, usually the day-shift fireman. He remains in this position until he obtains a license and is qualified to take the position alone. We do not issue manuals of instruction, but urge our employees to attend school when possible. Several men who have become first class engineers and fireman have been trained in this way.

We do not employ women operators in our plant.

LEROY E. VARNER,
Chief Engineer

LYNN GAS AND ELECTRIC COMPANY
LYNN, MASS.

EVERY OPERATOR in Massachusetts has to have a license of various grades to operate. This holds good despite the war and the manpower shortage. Our rule is to hire a man, possibly unlicensed, who is put with another man for training and teaching. His success and advancement depend upon his own initiative, application and, of course, openings for advancement. We prefer to advance our own men rather than hire men for the positions, believing that by providing the proper incentive we will always have a very alert and active personnel. To date we haven't used any women in the power plant.

We haven't any instruction manuals. Books, trade journals and the like are always available to everyone. We also stress safety.

We gradually got so shorthanded, through being unable to replace men, that we have very recently had to put the remaining men on a 6 and 7-day per week basis.

LEROY H. BARNARD,
Chief Engineer

JACOB RUPPERT BREWERY
NEW YORK

MANAGEMENT and operation of our power plant has not been crippled, to any great extent, on account of the shortage of help. All the men directly connected with the operation of the engine room, the ammonia system, boilers, etc., as well as the upkeep of the machinery in general, who have entered the Armed Forces have been replaced by the various unions.

We have, however, been obliged to employ a girl in the office of the power plant and her duties are that of a regular clerk. She keeps a record of the time, answers the telephone, changes the charts of recording instruments, compiles daily and monthly figures of the power plant operation, and takes care of any other clerical duties that come up.

WILLIAM M. SCHULER,
Plant Superintendent

MUNICIPAL LIGHT AND POWER DEPARTMENT
SIOUX FALLS, S. D.

ALL EMPLOYEES of this city are under Civil Service and must pass a Civil Service examination for any position that they apply for. At our power plant, most of the new employees enter either as utility men or machinist helpers. Our power plant is a combination electrical generating and water pumping plant using Diesel engines as the prime movers. We have found it very much to our advantage to train our own operators from the entrance classification. We have regular instructions with a blackboard for illustrations. These instructions are usually conducted by our chief engineer and have proved very satisfactory.

We have never used women in our power plant.

For the benefit of our employees we subscribed to the following publications:

POWER PLANT ENGINEERING
DIESEL POWER
DIESEL PROGRESS
WATER WORKS ENGINEERING

In addition to these, we have a reasonably-stocked library of technical and practical books by well-known authors, which is available to all employees. With the instructions given as outlined and the employees taking advantage of the library, we find that they have very little trouble passing the promotional examination which they must take before they can be advanced.

JOSEPH S. NELSON,
Commissioner

NEW YORK CENTRAL SYSTEM
NEW YORK

WE HAVE TRAINED our new and inexperienced men by having them work with and under the supervision of our experienced operating and maintenance personnel.

Up to now we have not found it necessary to employ women in our power plants.

We have found the two handbooks, "Questions and Answers" and "Practical Engineer's Manual," published by POWER PLANT ENGINEERING, very helpful in instructing our inexperienced men.

G. E. LAUTERBACH,
Supervisor Steam Power Plants

BOSTON EDISON COMPANY
BOSTON, MASS.

IN GENERAL, the training of the power plant personnel has been done by the supervisory staff and by placing the man on the job with the experienced man until he is competent to take over.

We have established accelerated training courses with instructors in certain classifications, such as Station Electrical Operators and Auxiliary Tenders for the steam sections of the station. Two groups of Auxiliary Tenders have been trained under this program and are now working.

All Station Electrical Operators are required to pass an oral examination in order to qualify for a higher grade.

We trained several women as Electrical Substation Operators during World War I, and there are two from this group still operating at a substation. It has not been necessary, up to this time, to employ any additional women for power plant work.

R. E. DILLON

THE CITY OF ALLIANCE
ALLIANCE, NEBR.

FORTUNATELY we have had very little turnover in our power plant over the last several years. Excepting for general supervision and maintenance work, our plant is operated by two men on each shift, a power plant operator and an assistant operator. New men are brought in as assistant operators.

Our plant is relatively new, being put in service in 1939. At that time I personally conducted a five months' course taught not only to our operators but also to other utility employees who were interested. We have had no major case of difficulty in the operation of our new plant and we have had a number of instances where our operators have saved equipment through their constant vigilance.

We have not used women in our power plant and do not contemplate doing so. It seems to me that we would have to use either all men or all women and a change at this time would be practically impossible. There should be no question in securing deferment for all vital plant employees, as these are most important to our war effort. In our case, we are the supplier of a large Army Air Base.

Referring to the course mentioned above, I used Part II and Part III of Heat-Power Engineering by Barnard, Ellenwood & Hirshfeld, published by John Wiley & Sons. I was more interested in getting the underlying data across to our men and then in our discussions studying our particular units. It seems to me that some such instruction is highly necessary, even for operators who have been in the game many years.

We have found that operators were doing certain things without a clear understanding of the reasons behind those things. Obviously, every failure of plant equipment cannot be studied in advance and it is only when operators

(*Continued on Page* 112)

The Topping Program At SHERMAN CREEK

Part I

The installation of the new topping turbine at Sherman Creek Station of the Consolidated Edison Company of New York marks an important event in the history of this station. Sherman Creek is one of the older stations of the Consolidated Edison System and for a number of years it has been a comparatively unimportant factor in the total capacity of the system. Now, with the installation of a new 1,000,000 lb per hr steam generator and a high pressure topping turbine the station begins to rank once again as an important element in the system. This topping unit marks the first in a program of four such units for this station and is the fifth in the overall program of expansion for the Consolidated Edison Company. The article by Mr. Roberts presented herewith describes only the steam generating part of the installation. Another article, dealing with the turbine section and describing the control of the auxiliary system, by H. Knecht, Division Engineer of the company will appear in the October issue

By R. T. Roberts ***Assistant Division Engineer***

Consolidated Edison Company of New York, Inc.

WHEN THE NO. 90 BOILER and turbine at Sherman Creek Station went into operation in April of this year the Consolidated Edison Co. of New York, Inc., completed the first step in a program of modernization of this station. The ultimate program calls for four high pressure boilers, each to serve one 50,000 kw turbine, the exhaust steam from each to generate one quarter of the station low pressure capacity.

The new boiler is designed to generate 1,000,000 lb of steam per hour at 1600 psi and 950 F at the turbine throttle. In the selection of these conditions, many studies comparing the economy of various schemes were made.

The planning started with the consideration of the ultimate installation, together with physical limitations of the site. The boiler room, which is bounded by three streets, is practically square, which dictated a symmetrical arrangement of four boilers for maximum space utilization. The amount of low pressure capacity for ultimate consideration is 196,000 kw. This amount of capacity could not be accommodated by two topping turbines since their capacity would have exceeded existing manufacturing limitations. As a consequence, four units were decided upon, the first of which occupies one-fourth of the available space and will supply sufficient steam to meet one-fourth of the ultimate requirements, or 49,000 kw. With this basic assumption the steam to be exhausted by the high pressure turbine was established, the capacity depending on initial steam conditions and the cycle arrangement. The higher the initial pressure and temperature the greater the capacity of the topping unit for a given exhaust pressure.

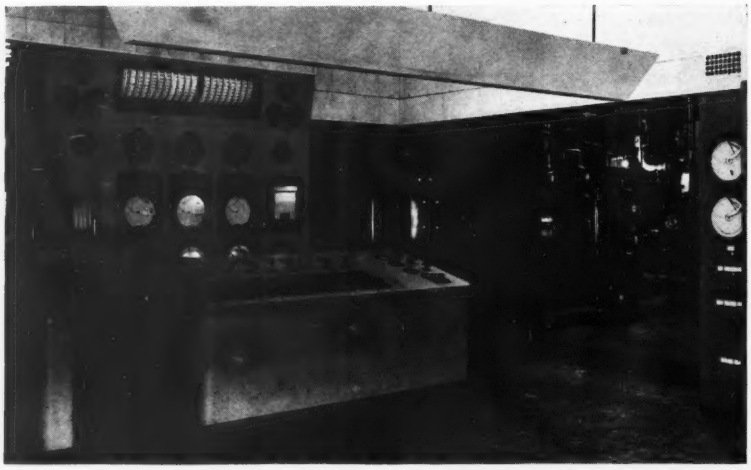


Fig. 1. Boiler Control Benchboard and Panel. Valve control and Alarm Panels at the right

In choosing the initial steam conditions and cycles for study, a number of inter-related factors had to be considered. The maximum safe temperature for carbon molybdenum steel established the initial temperature limit at 950 F. Preliminary studies indicated that the pressure should be made as high as was consistent with adequate steam temperature for the low pressure turbines, with due consideration to cost of boiler and other pressure parts.

With a fixed initial temperature to the topping unit, increasing initial pressure reduces 200 lb exhaust temperature, and vice versa. It was desired to maintain superheat about 100 F or above in the 200 lb steam to the low pressure turbines, since maintenance becomes excessive due to water erosion in the lower stages when sufficient superheat is not maintained. To meet these low pressure steam conditions without the expense of reheat, 1600 lb is the upper limit to initial pressure with 950 F temperature.

With existing limitations on drum welding and x-ray inspection the pressure limit for welded drums was approximately 1700 lb, or about 1600 lb at the throttle, de-

Fig. 2. View of the interior on the water-cooled furnace showing the arrangement of the bifurcated tubes around the burner openings. The boiler is tangentially fired by twelve burners, three located in each corner of the furnace. The opening for one of these sets of three burners can be seen in the lower center. The openings at the top, left, are for auxiliary burners, used only in case of insufficient superheat at low loads

ducting superheater pressure loss. Above this pressure forged drums were required with conventional boiler design, which added to the cost and time required for delivery.

The top pressure for welded drums with the top temperatures for carbon molybdenum steel resulted in an exhaust temperature from the topping turbine appropriate for the existing low pressure units. This fact dictated studies B_1 and B_2.

Scheme "A" in the following table was chosen as the basis of comparison since it represents conventional topping practice. The cost of additional capacity made available by higher initial steam conditions is shown in the table.

Higher pressures with reheat were considered, one typical case of which is shown in "D_1" but proved unattractive since boiler and piping costs increase substantially with increased pressure and reheat. At the time of making this study prices of reheat boiler equipment and necessary piping were such as to penalize the cycle. Since the low pressure turbines are built for a maximum temperature of about 600 F the economy of reheat is limited, while the major portion of the reheat investment would be required.

The accompanying table shows four of the many schemes used in the preliminary study based on a constant low pressure generator of 49,000 kw.

Table giving the results of preliminary studies.

Scheme	A	B_1	B_2	D_1
Throttle, steam, high pressure unit				
Pressure, lb/psi G	1250	1600	1600	2200
Temperature, F	925	950	950	900
Flow, lb/hr	765,000	839,000	885,000	888,000
Reheat Temperature, F	.....	.....	.....	900
Final Feedwater Temperature, F	386	446	488	533
Station Heat Rate, Btu/net kwh	11,415	10,965	10,900	10,650
Net Added Capacity, kw	37,260	43,865	44,930	48,380
Capacity Gain over A, kw	.....	6605	7670	11,120
Cost per added kw over A (value of basic capacity $100/kw)	.....	$26.80	$40.60	$108.00
Cost per added kw over B_1	.....	.....	126.20	226.50
Cost per added kw over B_2	.....	.....	.....	258.00

From the illustrations above, it can be seen that Scheme "B_1" having the lower basic added cost, would be the most economical and therefore established the initial steam pressure of 1600 lb at the temperature of 950 F.

The new boiler occupies the space originally intended for twelve 650-hp 200-lb boilers of which only the six first floor boilers have been installed. Six additional first floor boilers were removed to accommodate the turbine installation. This area provides enough space for the next topping turbine.

The boiler is of the three drum bent tube type designed for 1800 lb working pressure and was furnished, delivered and erected by the Combustion Engineering Co., Inc. The surface areas are as follows:

Boiler	12,906 sq ft
Water Wall	10,995 sq ft
Superheater	30,712 sq ft
Economizer	34,020 sq ft
Air Heater (each)	142,699 sq ft

The upper front drum is 54 in. in diameter, 5-3/32 in. and 4-11/16 in. thick. The upper rear drum is 60 in. in diameter, 5-3/16 in. and 4-27/32 in. thick while the lower drum is 36 in. in diameter and 3-13/32 in. thick. All drums are fusion welded.

The 60 in. diameter drum is equipped with a steam washer and drier. A feedwater pipe enters the drum and connects to a perforated feedwater trough over which is located a steam baffle of alternate hoods and spaces. Steam enters the hoods, passes through perforations in the hoods which are below the water line and emerges into the steam spaces. By this contact, the concentration of solids in the moisture in the steam is decreased. The

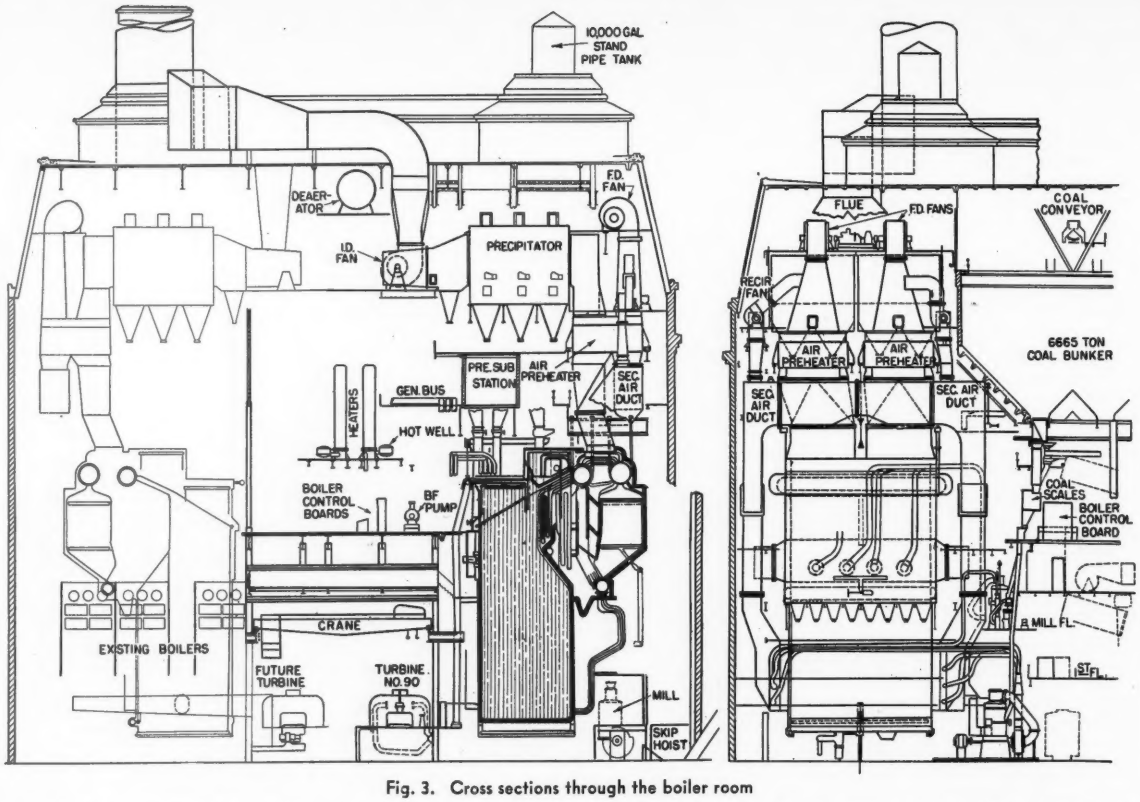


Fig. 3. Cross sections through the boiler room

steam then leaves the drum through rod-type driers.

The furnace is completely water cooled and is formed by 3 in. O.D. bifurcated tubes on 3-1/8 in. centers backed by special rolled steel sections to close the space between the tubes, steel plate, 2-in. of high temperature block insulation, a 3 in. rockwool blanket and steel casing. Roof and bottom tubes are finned and the rear wall tubes are bifurcated at the header end but not at the drum end. Furnace volume is 54,400 cu ft and liberation at 1,000,000 lb is 22,100 Btu per cu ft.

The Elesco superheater is of the pendant type and consists of two sections located behind the rear wall riser tubes and ahead of the boiler section. It is designed to raise the temperature of the steam to 955 F plus or minus 10 deg at a pressure of 1625 psi at the superheater outlet when the boiler is fired with pulverized coal and with excess air corresponding to 14 per cent CO_2 at the economizer outlet. The steam outlet temperature is controlled by a damper at the economizer inlet operated by a power cylinder and controlled by a thermostat in the superheated steam header.

Tubing in the superheater elements nearest the furnace is of chrome molybdenum alloy seamless low carbon hot finished steel tubing. The rear section near the economizer is of carbon molybdenum seamless low carbon hot finished steel tubing. Provisions for sampling saturated and superheated steam are included.

The superheated steam outlet header is equipped with a power controlled safety valve in addition to the Code requirements in order to more accurately control blowing pressure and blow-back.

Because of the fact that the boiler and turbine are one unit, no non-return valve was placed between the superheated steam outlet header and the turbine.

The Boiler Code thus covered the fabrication of the main steam piping up to the turbine throttle.

A split type Elesco economizer is provided, 2 in. diameter finned tubes 46 wide and 16 high each half on 8 in. vertical spacing and 3 in. horizontal spacing. The gas pass is up through the economizer with parallel water flow. The tubes are hot finished low carbon seamless steel and the entire economizer is designed for the most convenient access.

Two Ljungstrom air preheaters are located in the gas stream after the economizers. Heaters have 72 in. deep elements and are equipped for water washing of the surface. Recirculating fans are also pro-

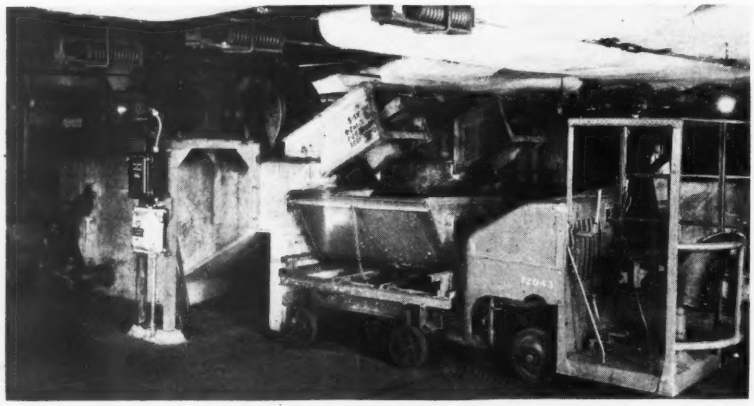


Fig. 4. The slag rake, slag car and the electric car hoist

vided to draw hot air from the heater outlets and discharge to the heater inlets. The object of the recirculation is to raise heater plate temperatures during periods of low load so that corrosion and fouling are diminished.

In order to maintain as clear a stack as possible, a Cottrell precipitator, capable of removing 95 per cent of the entrained solid material in the flue gas was installed. This precipitator is of the horizontal flow, steel plate electrode type, and is designed for a flow of 460,000 cfm at 340 F, being the largest of its type to date.

Dust and fly ash is handled pneumatically from the precipitator hoppers and points of lodgement in the boiler and duct work and deposited in ash pockets on the dock. The ash handling machinery is located in a room above the ash pockets and is in duplicate. The vacuum pumps are remotely controlled through push buttons from a control board located at the boiler. The system is arranged to operate either through automatic or hand control; the change from one loading point to another in system being controlled through sequence. From the ash pockets, fly ash is discharged through two rotary conditioners to render it dustless. These conditioners are installed in parallel and discharge to reversing conveyors so that the ash can be loaded either to barges or trucks.

A novel feature of the installation is the slag handling mechanism. As slag flows from the bottom, it falls through a water spray and disintegrates into particles about the size of rice. A leaf damper directs the slag to one of two pits, each having an inclined bottom. Mounted over each pit is a reciprocating slag rake, the motion of which is alternately backward (upward) and forward (downward). On the forward or downward motion, the rake is lifted above the slag and moved toward the lowest point of the pit. As the forward motion ceases, the rake is lowered into the slag and the backward motion starts. Slag is raked up the incline for a distance during this backward motion. The rake then disengages and starts on the forward motion and as this is repeated, the slag is brought to the top of the incline and drops over the apron into a car. The car is then dumped into the station skip hoist for hoisting to the ash pockets. The ash and slag handling system has been designed to make

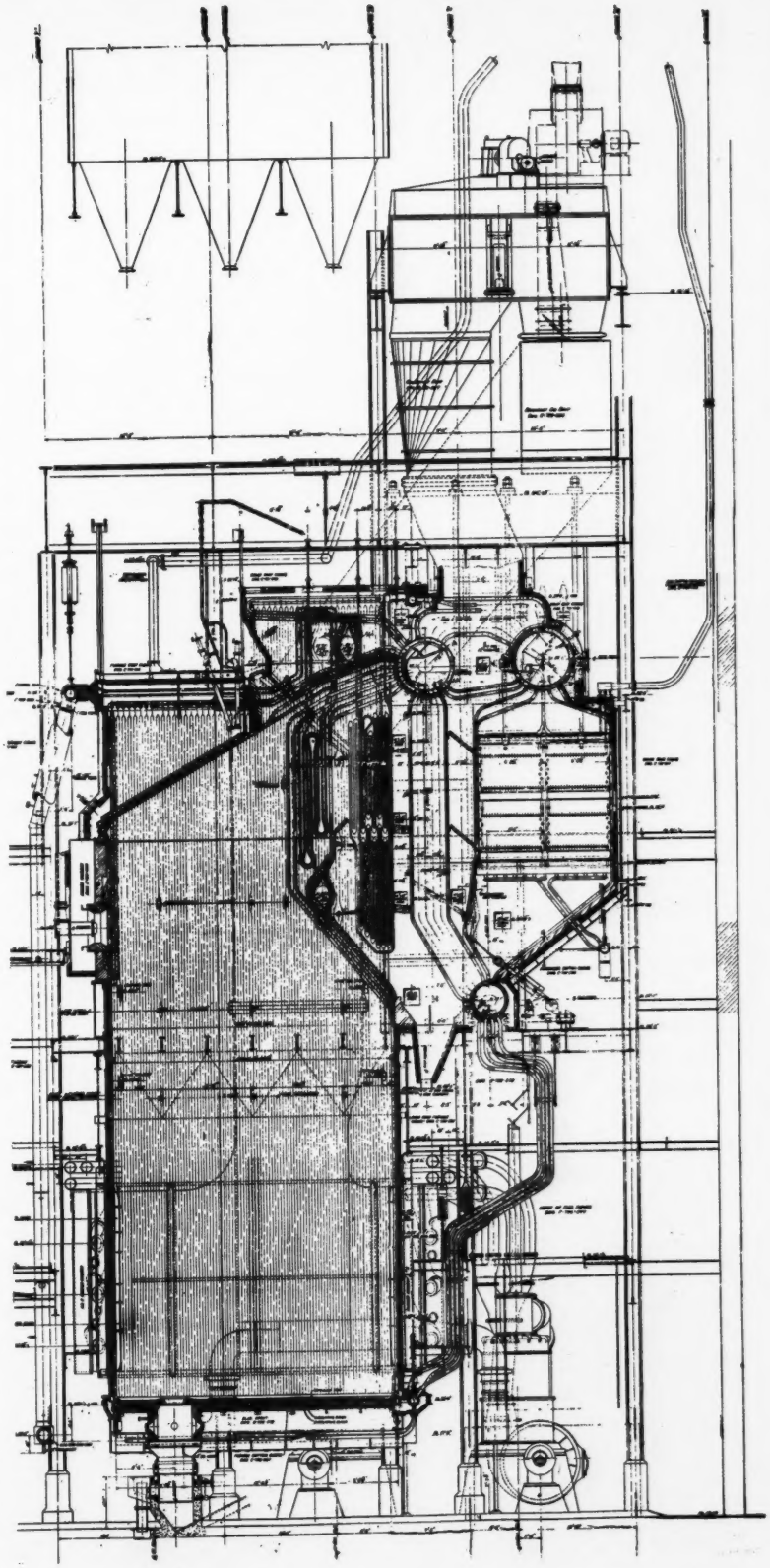


Fig. 5. Cross section through Unit No. 90

Fig. 6. The air duct between the forced draft fan and the air preheater is streamlined. The recirculating fan discharge is shown at the upper right

this work as clean and convenient as possible.

Flues between the boiler and air heater and precipitator and the ducts between the forced draft fan and the air heater are worthy of mention. They are of streamlined design to reduce to a minimum the losses, and are built without stiffeners.

The induced draft fans are B. F. Sturtevant No. 145 Turbovane units designed for 247,000 cfm at 13 in. sp. Two fans are driven through a single turbine located between the fans.

The I.D. fan turbine drive is a turbine gear set with a double-ended driving shaft. The turbine is a non-condensing unit having seven impulse stages. The reduction gear consists of a double helical gear and pinion having a ratio of 217/40.

The turbine has a normal rating of 1000 hp at 4930 rpm with 185 psi 485 F steam to the throttle and exhausting at 3 psi. It will develop 1410 hp at 5500 rpm with the same steam conditions.

The forced draft fans are American Blower Corporation No. 10 DI Standard DWHS, each designed for 147,000 cfm at 15 in. sp. Like the reduced draft fans, they are driven by a single turbine.

The F. D. fan turbine drive is a turbine gear set with a double-ended driving shaft. The turbine is a non-condensing unit having six impulse stages. The reduction gear consists of a double herring-bone gear and pinion having a ratio of 214/41.

The turbine has a normal rating of 574 hp at 5324 rpm with 185 psi, 485 F steam to the throttle and exhausting at 3 psi. It will develop 878 hp at 6134 rpm with the same steam conditions.

The furnace, boiler, superheater, heater, economizer and air heaters are provided with Diamond Power Specialty Corp. soot blowers. Motor driven telescope blowers are placed in the side walls to clean the superheater. Model III blowers are located in the roof to clean the superheater inlet. These blowers are cooled by air taken from the forced draft fan discharge. To eliminate individual piping and provide clearer working space and better conditions, this air is piped to a plenum chamber formed by the boiler roof steel so that a certain amount of cooling of the floor where the operator stands is accomplished before the air escapes through the soot blowers into the furnace.

Three Raymond Bowl type mills are provided designed to pulverize 32,700 lb each per hr based on coal

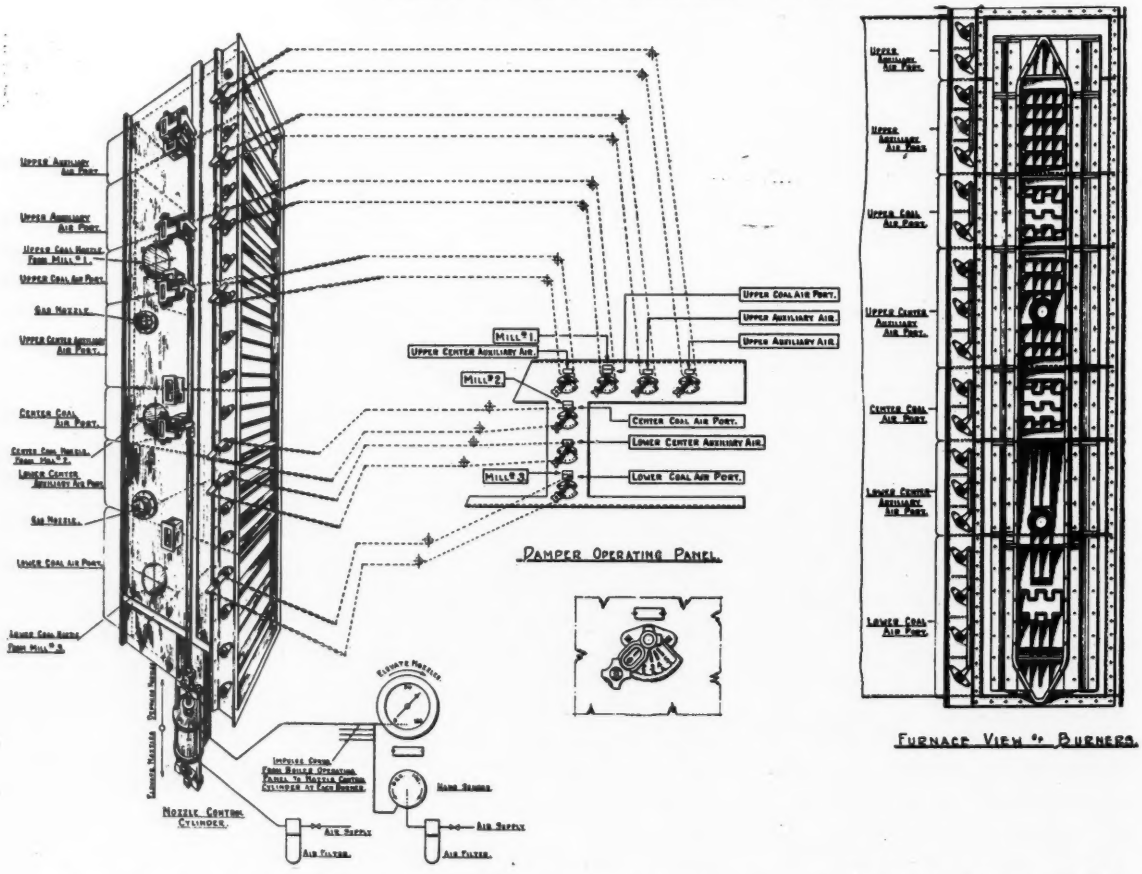

Upper Auxiliary Air Port
Upper Auxiliary Air Port
Upper Coal Nozzle From Mill No 1
Upper Coal Air Port
Gas Nozzle
Upper Center Auxiliary Air Port
Center Coal Air Port
Center Coal Nozzle From Mill No 2
Lower Center Auxiliary Air Port
Gas Nozzle
Lower Coal Air Port
Lower Coal Nozzle From Mill No 3
Mill No 1
Upper Center Auxiliary Air
Mill No 2
Mill No 3
Upper Coal Air Port
Upper Auxiliary Air
Upper Auxiliary Air
Center Coal Air Port
Lower Center Auxiliary Air
Lower Coal Air Port
Damper Operating Panel
Elevate Nozzles
Impulse Open From Boiler Operating Panel To Nozzle Control Cylinder At Each Burner
Hand Sender
Nozzle Control Cylinder
Air Supply
Air Filter
Air Supply
Air Filter
Upper Auxiliary Air Port
Upper Auxiliary Air Ports
Upper Coal Air Ports
Upper Center Auxiliary Air Port
Center Coal Air Port
Lower Center Auxiliary Air Port
Lower Coal Air Port
Furnace View of Burners

Fig. 7. Diagram of the burner control system. The burners are operated by an air cylinder located below the burner box which is controlled by a hand sender on the boiler control board

PRINCIPAL BOILER PLANT EQUIPMENT IN SHERMAN CREEK TOPPING UNIT NO. 90

STEAM GENERATING UNIT—1 Combustion Engineering Co., Inc., bent tube boiler, bifurcated, bare tube water walls, Elesco pendant type superheater, Elesco economizer, Ljungstrom air heaters; steam generating capacity 1,000,000 lb per hr, 1600 psi and 950 F; boiler 12,906 sq ft; water wall 10,995 sq ft; superheater 30,712 sq ft; economizer 34,020 sq ft; air heaters each 142,600 sq ft; furnace volume 54,400 cu ft; liberation 22,100 Btu per cu ft at 1,000,000 lb; tangentially fired, 3 burners per corner with gas ignition torches electrically fired; 3 Raymond Bowl type mills each driven by a 300 HP G.E. Co. 900 rpm, 3 phase, 60 cycle, 2300 v motor.

PRECIPITATOR—1 Cottrell precipitator manufactured by Research Corp. designed for 95 per cent removal when handling 460,000 cfm gas at 340 F; three sections long, steel plate electrodes with 4 electrical sets operating at half wave on the first two sections, full wave on last section.

INDUCED DRAFT FANS—2 B.F. Sturtevant No. 145 Design 9 Turbovane fans, double inlet, double width backward tilt self cleaning floats and with rectangular inlet boxes; designed for 247,000 cfm at 13 in. H_2O static pressure, 1020 rpm with 300 F gas.

INDUCED DRAFT FAN DRIVES—Each 2 fans are driven by a single Worthington turbine with double ended driving shaft; turbine rating 1410 hp at 5500 rpm with 185 psi, 485 F steam, exhausting at 3 psi non-condensing, 7 impulse stages; gear reduction double helical gear and pinion—ratio 217/40.

FORCED DRAFT FANS—2 American Blower Corp No. 10 DI standard double width high speed backward inclined blades; each designed for 147,000 cfm at 15 in. H_2O static pressure, 1175 rpm with 80 F air.

FORCED DRAFT FAN DRIVES—Each 2 fans driven by a single G.E. turbine with double ended driving shaft; turbine rating 878 hp at 6134 rpm with 185 psi, 485 F steam and exhausting at 3 psi; noncondensing—6 impulse stages; gear reduction 214/41.

RECIRCULATING FANS—2 Green Fuel Economizer recirculating fans each designed for 29,600 cfm at 5.5 in. H_2O static pressure, 560 F air temperature, 1775 rpm, single inlet, full housed with backwardly curved blades.

RECIRCULATING FAN DRIVES—2 G.E. Co. 75 hp, 1775 rpm, 3 phase, 60 cycle, 208 v direct connected motors.

FLY ASH HANDLING—United Conveyor pneumatic system with loading points at boiler, precipitator, flues and stack, discharging to ash and pockets on wharf through duplicate cyclone receiver and bag filters (1 set a spare); vacuum produced by Nash L-8 vacuum pumps in parallel (1 as spare), powered by G.E. Co. 75 hp, 1775 rpm, 208 v, 3 phase, 60 cycle motors; remote automatic and manual control from separate control panel at boiler; capacity 7½ tons of ash per hr.

FLY ASH CONDITIONERS—2 United Conveyor rotary ash conditioners installed in parallel below ash pockets; capacity each 25 tons dry ash per hr.

CONDITIONED FLY ASH CONVEYORS — 2 Stephens Adamson Mfg. Co. 30 in. wide reversing belt conveyors arranged to move outward and discharge to scows or move inboard and discharge to trucks; 2 hp, 116 rpm, 3 phase, 60 cycle, 208 v totally enclosed dust tight, weatherproof motors; capacity each 50 tons per hr.

COAL DISTRIBUTING CONVEYOR—1-15 in. side pull Redler conveyor by Stephens Adamson Mfg. Co., 167 ft long x 15 ft 4 in. wide centers; arranged to load at six points and discharge to 3 mills; capacity 20 tons per hr; powered by 2-7½ hp Westinghouse gear motors; motors 8.8 rpm, 60 cycle, 208 v, 3 phase located in diagonal corners in parellel.

COAL SCALES—3 Richardson Scale Co. totally enclosed dust proof all-electric automatic weighing hopper type, each designed for 25 tons per hr capacity.

COMBUSTION CONTROL — Republic Flow Meter arranged to regulate induced and forced draft fan turbine speeds and coal feed to maintain steam pressure.

FEED WATER CONTROL—Bailey Meter Co. 3 element control on steam flow, water flow and water level varies speed of boiler feed pumps.

CONTROL BENCH BOARD AND PANEL—Light gray Formica covered plywood on structural steel frame fabricated by Fiske Iron Works.

BLOW DOWN SYSTEM—Babcock & Wilcox Co., 1 high and 1 low pressure flash tank in series designed to flash 150,000 lb blow down per hr.

CHEMICAL FEED PUMPS—3 Proportioneer duplex high pressure chemical feed pumps (1 spare) for phosphate and caustic; capacity range each cylinder 0.03 to 0.3 gpm at 2200 psi.

FEED WATER TREATMENT—Permutit Co. sodium-hydrogen Zeo-Karb softening system designed to soften 50,000 lb per hr of Croton water.

having a grindability of 55 Hardgrove scale, with 8 per cent moisture and grinding to a fineness of 70 per cent through 200 mesh. Provision for 4 auxiliary burners in the vapor front wall was made in case superheat was low at low load.

The boiler is tangentially fired by 12 burners, 3 located in each corner. One mill serves the same burner in each corner so that with one mill operation all four top, middle or bottom burners would be in service.

Gas ignition torches are placed between each pair of burners, two to a corner. These ignition torches are automatically controlled from the control board, a separate control for each tier of torches. Solenoid operated gas valves control gas flow so that no flow can occur unless the igniters are energized.

The burners are arranged so that the bottom burner in each corner is stationary and the top two burners adjustable in the vertical direction.

The burners are operated by an air cylinder located below the burner box which is controlled by a hand sender on the boiler control board. Elevation is also indicated at the board by a dial. In addition, each burner is equipped with a tilt adjustment and indication at the burner which shows the angular movement of the burner with full stroke of the cylinder. The entire ignition and burner system has been designed to be easily and safely operated with a minimum of labor.

Preparatory to installation of the boiler, a belt conveyor system was installed in order to remove the coal cable road over which fuel was originally handled in the station. A system of belt conveyors serving the two towers on the dock was installed above the bunkers in the station. Below the bunkers serving this installation a run-around Redler conveyor was installed in order that the coal which would not flow by gravity to the mills could be moved. In order to simplify the

(*Continued on Page* 114)

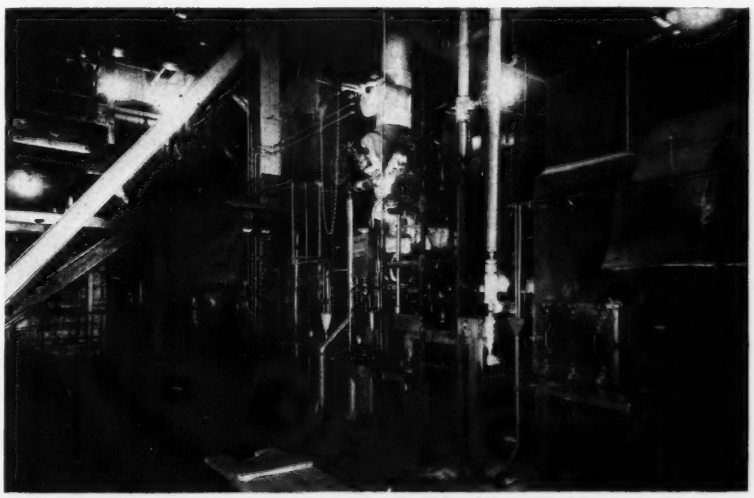


Fig. 8. Turbine driven induced draft fans

The Role of Capacitors in War Work

Few besides those who are actually concerned with the application of capacitors realize how valuable these devices have been in conserving vital war materials. In relieving generating and distribution systems of reactive currents the effect of capacitors is that of adding generating capacity. To show the importance of capacitors the author works out several typical numerical examples

By R. E. MARBURY

Capacitor Engineer
Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pa.

CAPACITORS have been used more and more during the past 18 yr for power factor correction, yet utilities in general still continue to supply the major portion of the wattless current necessary for the operation of low power factor loads. Power systems were usually built generously enough to apply the necessary power plus the reactive kva demanded by such loads. Capacitors were first used on systems where the wattless burden became sufficiently great to require a system of rates encouraging installation of capacitors. During 1937 many utilities began installing capacitors to release system capacity; expanding loads could thus be handled with a minimum increase in investment. Now war industries have added still more low power factor loads and as a result it has been necessary to relieve generating and distribution systems of reactive current on a scale never practiced before. The program has avoided very large investments in new lines, generators, and other equipment and has thereby conserved vital war metals so urgently needed for other purposes.

The need for capacitors is generally indicated by the power factor which if low shows that the system is supplying a great deal of wattless current. The following table shows the burden imposed on the power circuit at different power factors, based on a typical 4 kv feeder using 4/0 bare copper with 3 phase equivalent conductor of 3.36 in.

Normally a system power factor of 70.7 per cent is considered relatively good, yet from table I it will be noted that for this condition the reactive component is just as great as the power component; the total voltage drop is 1.83 times as great as the drop at 95 per cent power factor and the current is 1.4 times as great. It is obvious that if this 40 per cent excess current is eliminated by means of capacitors, the line will be able to handle considerably more load. If the 5.81 per cent drop was permissible before capacitors were installed, the line can now be loaded until the same drop is reached again; if the current at 0.7 power factor was previously satisfactory the load now can be increased until that particular current is again reached. Sometimes current is the limiting factor and sometimes voltage drop determines the total load that can be handled. The use of the expression power factor is simple enough, but in recent years a practice has developed wherein it is used to express many different conditions; monthly power factor, demand power factor, average load power factor and instantaneous demand power factor are quite frequently heard. To simply say that capacitors are needed to improve power factor is not enough. Therefore the principal purpose of this article is to clarify and discuss the various types of power factor correction problems.

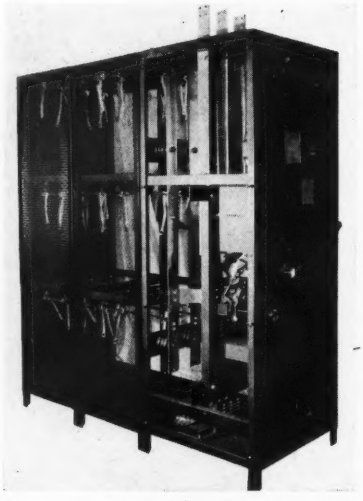


Fig. 1. Three phase 540 kva voltage-controlled automatic capacitor bank. The capacitor units and the side screen on the circuit breaker cubicle are removed. Primary voltage relay is shown on the front of the rack. Space and flexible connectors accommodate 36-15 kva capacitor units

Problem No. 1—Correction of Average Load Power Factor

Consider the case where electric service rates are high because of a plant's low average power factor. Suppose the utility needs the system capacity now tied up with wattless current and offers a rate to the consumer encouraging the installation of capacitors. Such capacitors will supply the reactive kva for the plant but will make no appreciable saving within the plant itself; it therefore follows

Table I

P. F. of Load	Per Cent Kw. Com.	Per Cent Reactive Com.	Per Cent Per Mile Drop Due to Kw	Per Cent Per Mile Drop Due to R Kva	Total Drop Per Cent Per Mile	Total Relative Current Flowing Per Cent
99	100	14.2	1.89	.56	2.45	100
95	100	33	1.89	1.29	3.18	104
90	100	47.8	1.89	1.94	3.83	110
85	100	60.5	1.89	2.43	4.32	116
80	100	75	1.89	2.94	4.83	124
70.7	100	100	1.89	3.92	5.81	140
60	100	133	1.89	5.21	7.10	165
50	100	173	1.89	6.80	8.69	198

that the capacitors are installed entirely for the benefit of the utility. Some capacitors are to supply only the average reactive current, they are usually located at the service entrance and may be indoor or outdoor type; generally they are left on the line at all times. Computing the rating of this capacitor is a simple operation based on average kw, existing power factor and desired power factor. There are some conditions which may need special consideration as enumerated below.

(a) Special Case—Over Voltage During Light Loads.

If the power factor is raised a considerable amount, say from 60 to 99 per cent, the capacitor may cause an appreciable boost in voltage at this point on the circuit. The voltage rise, when the plant is shut down, may be sufficient to shorten lamp life and to produce other objectionable effects; its value may be computed by multiplying capacitor current by line reactance.

$$\text{Per cent voltage rise} = \frac{\text{C kva} \times d \times X}{10 \times kv^2}$$

C kva = Three phase capacitor kva

d = Distance in miles to source of power

X = Line reactance in ohms per mile

kv = Line voltage in kilovolts.

When calculations show that the voltage rise will be excessive under light load conditions, a part or all of the capacitor must be switched off with the load. This can be done by the operator or by automatic means; the latter method, which is now quite commonly used, requires an electrically operated switch controlled by a relay responsive to measured voltage.

(b) Special Case—High Supply Voltage.

Where the supply voltage is 7200 to 13,800 v, the cost of capacitors and their switching equipment is higher. In such cases it may be more economical to install a number of small banks, placing them on the secondary circuits, even though there is no other reason to apply the capacitor to these circuits. This will not be true for 230-v secondary circuits since 230-v capacitors are also costly per kva.

(c) Special Case—High Ambient Temperatures—Acid Fumes—Hazardous Conditions.

For ambient temperatures above 40 C or where there are corrosive fumes or hazardous conditions, it is usually far more economical to isolate outdoor-type standard capacitors from the undesirable conditions rather than to obtain special capacitors to meet the unusual service requirements.

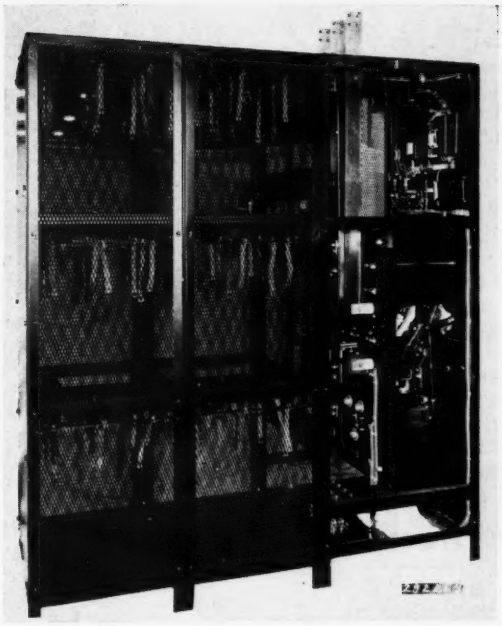


Fig. 2. Three phase 540 kva voltage-controlled automatic capacitor bank — showing details of automatic control and electrically operated air breaker with its own Rectox power supply. Mechanisms are used to provide time-delay energizing or deenergizing to avoid frequent switching due to fluctuations in voltage of short duration

(d) Special Case—Bad Wave Form.

When the wave form is bad due to presence of harmonics, special filters and chokes may be avoided through use of small capacitor units; they should be placed as far out as possible on the secondary feeder consistent with load distribution. In this way greater impedence is introduced ahead of the capacitor; thus harmonics will probably not constitute an overload on the unit. As a further precaution, large banks are automatically disconnected during light load periods, since harmonic difficulties usually occur during that time. Automatic control may be obtained in several ways, a number of which are enumerated below.

(1) Capacitor banks having an electrically-operated switch controlled by voltage on the circuit.

(2) Capacitor banks having an electrically-operated switch controlled by circuit current flow.

(3) Capacitors direct-connected to motor terminals which are switched off with the motor. In this case excess capacity should be avoided. The capacitor rating should not, as a rule, be greater than the no-load motor magnetizing kva.

Problem No. 2—Correction of Demand Power Factor

Here the capacitor size is based on the power factor determined during peak demand periods. Since this type unit will be larger than one installed merely to raise the average power factor, light load voltage conditions must be given very careful consideration. If the demand is large compared to the average load, it will very likely be necessary to disconnect the capacitor during light load periods. Special cases of Problem 1 (a), (b), (c), and (d) also apply to Problem No. 2.

Problem No. 3—Correction of Monthly Power Factor

Many power rate schedules take into account the power factor as determined from the reactive-kva hours and kw hours integrated over the month. For example, one typical schedule makes use of a billing demand. This billing demand is computed by multiplying the kw demand by a factor based upon the ratio of R-kva hours and kw hours for the month.

$$\text{Billing Demand in kva} = \text{kw dem'd} \sqrt{1 + \left(\frac{\text{R-kvah}}{\text{kwh}}\right)^2}$$

In a case of this kind the capacitor leading R-kva hours reduce the lagging R-kva hours accumulated during the month. A capacitor of a given size, operating continuously, will produce leading R-kva hours which can be easily calculated from the number of hours in the month but meters do not respond to capacitor reactive developed in excess of lagging reactive requirements at any given time. Thus when the load varies

during the month, it is necessary to determine the smallest size capacitor which will accomplish the desired result, the capacitor being on the line continuously. This is readily explained by an example. Consider the case of a plant operating under the following conditions:

kw day load average.....960 kw
kw demand.....1200 kw
kw hrs for the month..314,550 kwh
R-kva hrs for the month.....337,146 R-kvah

Assume it is desirable, from an economic standpoint, to raise the monthly power factor to 95 per cent. This means that the R-kva hours have to be reduced from 337,146 to 104,700.

$$\text{kva at 95\% P.F.} = \frac{314{,}550 \text{ kw}}{95\% \text{ P.F.}} = 331{,}000 \text{ kvah}$$

Reactive kva at 95% P.F. =

$$\sqrt{331{,}100^2 - 314{,}550^2} = 104{,}700$$

From 337,146 we subtract 104,700 and get 232,446 R-kva hours to be cancelled by capacitors. This simply means that the product of the capacitor kva times the hours it is effective must equal 232,446. A 319 kva capacitor connected to the circuit and operated continuously throughout a month (730 hr), will produce 232,446 capacitor-kva hours. Using meters without ratchets, a 319 kva capacitor will meet the requirements since the 232,446 capacitor-kvah will offset the 232,446 R-kvah caused by magnetizing current. If the load is reasonably uniform throughout the whole month, so that the 319 kva capacitor will never correct the power factor to leading, the installation will be satisfactory even with ratcheted meters. However, should the load vary over a considerable range, the 319 kva capacitor will at times produce a leading power factor. As a result the R-kva meter must run backwards to establish full credit for the capacitor-kva hours. With ratchet-type meters this is impossible so they record only capacitor-kvah accumulated during periods when the power factor is other than leading; this requires a larger capacitor.

The first step in the solution of such a problem involves a careful examination of load variations throughout the month noting especially the recurring periods. Having first determined the lowest level, probably occurring during the week-end, then the next higher load level is located; normally this involves first the night load and finally the day load. The next step is to determine the total hours in the month corresponding to these different levels, or load periods.

Using the same problem as above, a table may be prepared based on data obtained from the plant operating schedule. This table is shown here as Table II.

Table II

Period of Month	Average kw Load During Period	P. F. During Load Period Per Cent	Reactive kva Component	Hours Per Month for Load Per.	Maximum Effective Size Capacitor	Hour Portion of Mo. Capacitor Effective	Cumulative Effect Capac. kva hours
Weekend ..	64	50	111	240	111 kva	730 hr	81,030
Night	260	76	222	168	222 kva	490 hr	135,420
Evening ...	640	70	650	168	650 kva	322 hr	273,236
Day	960	67	1065	154	1065 kva	154 hr	337,146
Totals.....	314,550		337,146		730		

The data shows the lowest level of power occurs during the week end, thus a 111 kva capacitor will be 100 per cent effective over the entire month, or 730 hours. This small capacitor can therefore build up 81,030 kvah. Under all conditions the power factor will either be 100 per cent, or lagging; it never will be leading. It was shown that 232,446 effective capacitor-kvah were needed and so the size of the capacitor is easily computed.

111 kva capacitor × 730 hr = 81,030
111 kva additional × 490 hr = 54,390

Total effective week end and night 135,420

Balance needed = 232,446 — 135,420 = 97,026

Available hours remaining during evening and day = 322 hr

$$\frac{97{,}026}{322} = 301 \text{ kva capacitor}$$

The installation of a 301 kva capacitor, operating 322 hr per month, will build up the needed additional 97,026 R-kvah.

During the 322-hr period the total capacitor-kva will be:

111 + 111 + 301 = 523 kva

The 301 kva capacitor added during the evening is less than could be used during this period, so the day period can be ignored. Therefore, a 523 kva capacitor will cancel out 232,446 lagging reactive kvah and the complete installation may be operated as follows:

During week end, 111 kva
During night, 222 kva
During evening & day, 523 kva

The total of 523 kva may be operated continuously throughout the month if the voltage rise is not excessive during light load periods. This avoids the necessity for automatic or manual switching. Of course, the kva value of the capacitor bank may be rounded out to the next higher standard size which is 540 kva.

Now suppose a greater portion of the R-kvah must be cancelled out in order to get almost unity power factor on a monthly basis. (For the figures, refer to double column calculations below.)

Where a plant has, for example, 960 kw day-load with practically no night or week-end load, the transformer bank may be considered as a low-load level if metering is on the primary side. Example:

Day load—960 kw 154 hr per month 67% P.F.

Evening—Negligible.

(Continued on Page 114)

$$\text{kvah at 98\% PF} = \frac{314{,}550}{98\% \text{ PF}} \text{ kwh} = 320{,}000$$

Reactive kvah at 98% PF = $\sqrt{320{,}000^2 - 314{,}500^2} = 55{,}000$

337,146 — 55,000 = 282,146 hr to be supplied by the capacitor

	R-kvah	*Cumulative*
111 kva capacitor × 730 hr	81,030	81,030
111 kva capacitor additional × 490 hr	54,390	135,420
428 kva capacitor additional × 322 hr	137,816	273,236

From 282,146 we subtract 273,236 and get 8910 R-kva additional capacity required which must be obtained in the 154 hr day load period.

8910 ÷ 154 = 58 kva capacitor

Now the total capacitor-kva required will be 111 + 111 + 428 + 58 = 708 kva.

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

MR. MUIR AND HIS MAGNET

One swallow, it is said, does not make a summer, but here is a story of a swallow that created a lot of trouble. On June 12, Donald Brown, a 5-yr old inhabitant of Brooklyn, for no particular reason at all, swallowed a steel lock an inch long and an inch and a half wide. After several examinations and consultations by physicians and after concluding that there was no hope of extracting the lock from the boy's throat except by surgical operation, Dr. Silber, a child specialist, conceived the idea that it might be removed by a magnet. Various electrical equipment makers, however, reported that an electromagnet would not be feasible but finally someone suggested the use of a permanent magnet with unusually high coercive force.

At this point the General Electric Co. was called on, and on June 23, nine days later, Roy C. Muir, Vice President of G.E., flew to New York from Schenectady with a specially made magnet, only one inch long, 1/8 in. in diameter and made of "Alnico" (aluminum-nickel-cobalt) alloy.

As reported in Nickel Steel Topics, with this magnet the lock was pulled as far as the boy's esophagus and at that point, it was snared with a special instrument and finally removed from his throat.

While this has nothing to do with power plants it was a good practical solution to a difficult problem which engineers can appreciate. Maybe the moral of this story is, "Keep an Alnico magnet in your first aid kit" but don't deliberately go around swallowing locks.

—A.W.K.

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE
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How To Operate Large Boilers

Here is an article that should be of help to many of the newer men now engaged as boiler plant operators. It tells exactly how to operate large boilers; how to first put them on the line, what to look for during the process of warming-up, how to keep them going and how to remove them from service. In addition, the author gives detailed instructions in regard to the operation of forced- and induced-draft fans and Lungstrom type air preheaters. It would be well to post this article somewhere in the boiler room so that the operators can become familiar with the instructions.

By J. L. MASSIE
District Manager, Henry Vogt Company, Dallas, Texas

THE SCARCITY of skilled boiler operators has made it necessary in many plants to make use of men without too much knowledge or experience in boiler operation. This has introduced many problems. Unless these men are given some sort of training or unless they are very carefully supervised, they may cause serious damage to equipment. Even with small boilers it is necessary for the operators to know the correct procedure of operation but in the case of large, high-pressure steam generating units it becomes imperative that they understand what they are doing.

At the present time when not only men but also materials are scarce, the tendency in boiler plant practice is to use larger and fewer units rather than a number of small boilers. Since many of such large units have been installed in existing boiler plants where the other boilers are small, it becomes very important that the operators, who may be perfectly competent to operate the small boilers, be instructed in regard to the operating procedure required by the large units. The process of putting large boilers on the line is a more or less involved procedure requiring careful attention to many relatively small but important details.

On the financial side of the picture, the boilerhouse engineer who formerly operated a boiler which represented an investment of, say, $25,000, cannot be entrusted with the responsibility of handling a single unit that may involve as much as a quarter of a million dollars, without considerable preliminary training.

The purpose of this article is to outline the operating procedure required for the proper operation of large steam generating units, particularly the initial starting-up of such units. Nothing is more important in the initial starting-up of a new unit than the thorough drying out of the furnace and the boiling out of the internal surfaces with a solution of soda ash. The purpose of this is to remove any trace of oil deposit that may have been left in the boiler during manufacture and erection.

The basic principles of boiler operation as outlined in the following paragraphs should be of help to many men now engaged in the operation of our larger boiler installations.

Warming up a new steam Generator

Check inside of boiler drums carefully, to make sure that there are no obstructions.

Check inside of furnace to make sure there are no obstructions, such as wood platforms, etc.

Fill boiler with raw water, allowing a good portion to run out of blowdown valves, to wash out any dirt or mill scale that may be in the boilers.

Put required quantity of soda ash and caustic soda solution in top drums, distributing along the length of the drum, then close drums ready for starting, adding additional water to bring up water level to the proper height.

Build a slow *wood* fire in the bottom of furnace, on both sides of furnace, if possible, for distribution of heat, utilizing natural draft only.

Keep this fire going continuously for 48 hrs at least, and during this period, keep drum vents and superheater drains open.

Maintain only enough fire in furnace to bring up heat, but not enough to generate any pressure.

After drying out period, close vents and drains, and bring boiler pressure up to about 10 to 15 lb, with one of the regular burners, and hold the boiler at this pressure for about 8 or 10 hr. During this time, the vent can be opened periodically to allow steam to escape, and assist in the boiling action.

Allow boiler to cool for about a day, or until temperature is sufficiently low to allow complete drainage and flushing of the inside boiler surfaces, by hand hose if possible, and keep flushing until clean water starts coming out of the blowdown.

Add chemicals for initial operation of boiler, close drums and fill the boiler to proper level.

During the drying or warming up period, the exterior of the boiler and furnace should be carefully examined to watch for any openings that might be caused by expansion. Any openings that develop in setting around drums or headers, should be closed with flexible insulation, to prevent air infiltration. Also watch for any undue strains that might be set up on the connecting boiler piping.

Make sure boiler vent is open, and make sure that the superheater drain is open, and that there is no water in the superheater.

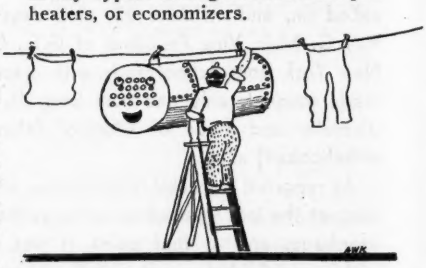
Check furnace to make sure that proper draft is available, and no fuel has escaped into the furnace.

Start induced draft fan, and purge furnace, and keep fan running slowly, so as to obtain just enough draft to maintain combustion.

Bringing up a Boiler

Make sure the feedwater pumps are operative. See that all steam, fuel, and blow down valves are closed and feedwater valves are operative; check water columns, and open the superheater drains and vent on boiler steam drum.

The boiler should be brought up on natural draft. Open the uptake dampers, or damper on induced draft fan, whichever the case may be; close any bypass dampers that may be installed in any bypass arrangement around preheaters, or economizers.



Putting a boiler on the line

Do not attempt to light a burner for at least two minutes. Air should be circulated through the furnace and passes to the stack during this time, in order that any combustible gas within the setting will be removed. This precaution is necessary to prevent any explosion of the gases which may have collected since the boiler was last in service, or during the starting up period.

See that the water is showing in the water column, about two inches is correct level when the boiler is cold. If the boiler water is too high, blow down to proper level in glass.

See that all burners are properly clamped in place, and that burner connections are tight. Using natural gas as fuel, insert a lighted torch with a substantial wick, at the flame tip; open

the stop cock at the gas burners, then crack the individual stop valve behind the cock, and open burner damper.

As soon as flame is caught, gradually open the fuel stop valve and damper, so as to get a medium sized stable flame. Follow same procedure as additional burners are added. The first burner lighted preferably for distribution, should be the bottom center burner, and *do not attempt to light one burner from another.*

Two burners should be used for starting up and operated with a medium flame, to bring up the steam pressure at 10 lb in about 3 hr; hold pressure at 10 lb for about 2 hr, and during this period, thoroughly check the boiler installation for any undue expansion, then slowly bring up pressure hourly at increments of 100 lb, checking expansion as pressure increases.

The vent on the boiler drum should be wide open when the boiler is zero gage, and should be left wide open for at least 30 min after the boiler is steaming, in order that the non-condensible gases about the water level will be driven off.

When the steam pressure in the boiler rises to 10 lb, leave the outlet drain at the automatic non-return valve wide open, and close the other superheater drain valves. Reopen the drain at the superheater inlet approximately two revolutions, and leave this way until the pressure in the boiler is within 15 lb of the header pressure, at which time open the valve wide. Leave both valves wide open until the boiler is on the line, and then close them. Having both valves open during this period will prevent wet steam from being carried through the superheater, into the steam header.

During this period watch the water closely and blow down to the proper level if the water rises to within 2 in. of the top of the glass. This is important as a sudden drop in the main steam header pressure below that of the boiler being brought up, would pull the boiler on the line with a consequent rise in the water level.

When the steam pressure in the boiler reaches 100 lb slowly charge the steam header, if it is not already charged, and then open the automatic non-return steam stop, carefully checking the superheat during starting period to prevent pushing the boiler too hard, with consequent burning of superheaters.

At least 4 to 5 hr will normally be required to bring a cold boiler on the line (the exception being when the boiler is having its inital trial run), two and one-half hours from bank at 100 lb pressure, and approximately one hour from bank at 250 lb pressure.

During this period the induced draft has been started to obtain sufficient draft to maintain around 0.10 in. in the furnace, and when the boiler comes on the line, *but not before,* start the forced draft fan and add burners as needed.

Boiler Operation

1—Control feedwater flow by hand until boiler is operating normally on line, then cut in the feedwater regulator.

2—Watch for flaming burners and see if it is getting sufficient air. Possible clogging of the tips may also cause trouble.

3—If using Bailey flowmeter, keep pens together, otherwise develop firing chart giving draft loss across burners to various gas pressure at burners. Use this, or some other means, to maintain correct combustion conditions.

4—If for any reason the feedwater temperature for which the unit is designed, is lost, the superheat temperature will immediately start to rise, and care should be taken so that this temperature is not allowed to rise above the design limits of the superheater and turbine, and if necessary, promptly take boiler off the line.

5—Make routine inspection of outside of boiler in order to observe any unusual conditions, such as cracks in setting, water or steam leaks, etc.

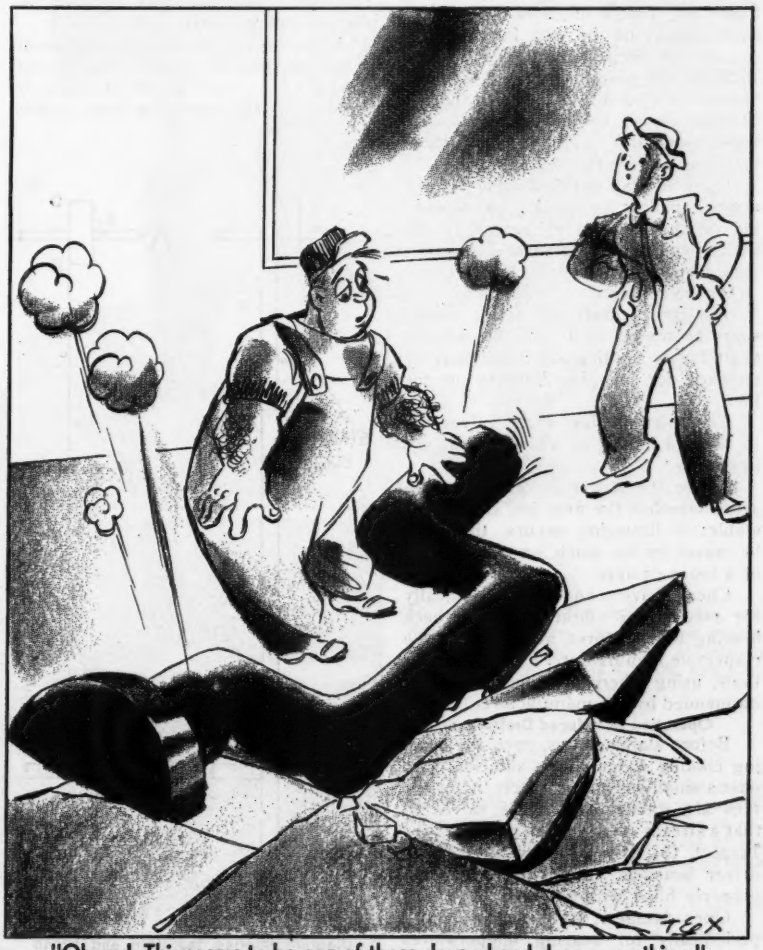
6—Develop definite routine, watch procedure for boiler blowdown, and feedwater and boiler water sampling and testing.

7—Keep careful check on flue gas temperature versus steam flow, to make sure that the boiler surfaces are clean, and the baffles tight. A table should be prepared when boiler is new so that a standard set of conditions are formulated.

8—If the installation includes automatic control equipment, it is advisable to get the manufacturer's service engineer to initially adjust the equipment, and train the operating personnel.

Removing the Boiler from Service

Decrease the gas pressure in such a manner that the load can be readily shifted to the other boilers in service. Cut out the outside burners first, leaving the center burner until last. As each burner is cut out, close the individual air damper and pull the burner and deflector back as far as possible. (Pulling the burner and deflector back will prevent them overheating.) Then crack slightly open the individual air damper to prevent heat from the furnace damaging the damper operating mechanism. When the steam flow on the boiler is approximately 35,000 lb per hr, close the gas throttle valve at the front of the boiler, and then close the stop cock at the burner header. (This will avoid having gas pressure in the header



"Oh my! This seems to be one of those days when I drop everything."

when this last burner is cut out). Close all individual burner valves tight and open the ½ in. bleeder valve on the gas header, which will allow any gas remaining in the header to escape to the atmosphere. If this were not done there would be danger of gas leaking into the furnace and thereby increasing the chances of an explosion. Close the windbox, downtake, uptake, and draft fan suction dampers. Stop the draft fan and shut off the fan bearing cooling water. Close the hand feedwater valve. Maintain approximately 6 in. of water in the gage glass while the boiler is banked near header pressure.

A higher water level in a boiler that is banked near header pressure is undesirable, as a sudden heavy pick-up in load, resulting in the main steam header pressure dropping below that of the banked boiler, would pull the boiler on the line, and hence, wet steam or water into the turbine.

If the boiler is being removed from service for repairs, close the automatic non-return valve when the boiler pressure is low enough that the heat from the furnace will not raise the pressure to the set pressure of the valve.

Operation of Forced Draft Fans

Before starting a forced draft fan, inspect the driver bearing oil cups to see that they contain oil; also inspect the gage glasses of the two fan bearings to see that they contain ½ in. of oil. Refill to the proper level any bearings that are low on oil. Next, open the fan bearing outlet cooling water valves wide open, and open the inlet water valves about one full revolution.

Open the fan outlet damper for the desired air flow for starting up, depending on the number of burners to be used, then open the fan suction damper wide open and use the discharge damper for air control.

The forced draft fan driver *should never be started* until after the induced draft fan is running and additional air required for bringing burners on the line.

The inlet cooling water valves are to be kept closed on all draft fans not in service.

While the fan is in operation, observe whether the fires are steady and stable; if fluttering occurs, this may be caused by too much, or too little air, or a loose damper.

Check drivers and fans periodically for mechanical vibrations, and check bearing temperatures, according to the respective manufacturer's recommendations, using where possible, oil as recommended by fan manufacturer.

Operation of Induced Draft Fans

Before starting fans, open the bearing cooling water valves sufficiently to pass a small stream of water. After the fans are started, adjust the valves so that a stream of lukewarm water passes. Inspect the fan bearings as well as driver bearings, to see that they are properly filled with oil.

Open dampers, start fan, and check periodically for bearing temperatures and general mechanical vibrations.

Operation of Preheaters of the Lungstrom Type

Inspect the three roller bearings, and drive bearings on each preheater to see that the reservoirs have sufficient oil. Oil should be within ¼ in. of the top of the inspection cup. See that the sight feed oil cups for each preheater drive gear is filled and regulated, to feed one drop of oil in three minutes.

The preheaters are to be started before the boiler is fired; also before the induced and forced draft fans are put in service.

Check the preheater element and drive, periodically, when operating, for mechanical vibrations, and the elements for moisture formations caused by possible gas discharge temperature below, or approximating dew point.

How To Align Pulleys and Sheaves

By W. F. SCHAPHORST

THE ACCOMPANYING SKETCH marked "wrong" shows how pulleys are sometimes aligned. A long pole or board is used as a straightedge in the manner shown. That method is all right provided the straightedge is really straight, but usually they are NOT straight. They may have every appearance of being straight, and yet they are crooked. Sometimes they are straight when lying on the floor, but when lifted and supported at one end they deflect more or less and may become inaccurate and undependable. Therefore, don't use that method for aligning pulleys, sheaves, or sprockets.

A method that assures true alignment is the one labeled "right." Use a cord instead of a straightedge. A cord is readily carried around in your pocket and is available anywhere on a moment's notice. Then when pulled taut a cord always is perfectly straight with respect to a vertical place. A cord does not warp. Boards, poles, sticks, etc., do warp.

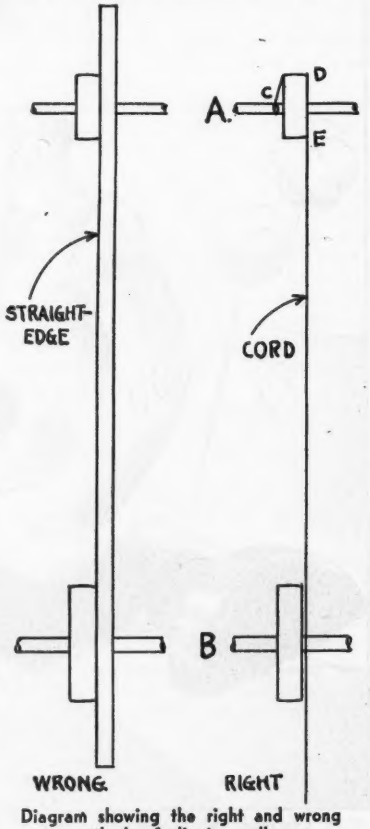


Diagram showing the right and wrong methods of aligning pulleys

As shown in the sketch labeled "right," tie the cord to shaft A as at C, hitch it around the pulley so that the cord makes contact at two points D and E almost diametrically opposite. When "just touching" E the cord is an accurate gauge for locating the pulley on shaft B. As indicated here the pulley on shaft B will have to be moved to the right or the pulley on shaft A will have to be moved toward the left to secure proper alignment.

A thing to watch out for in the aligning of pulleys is "pulley wobble." It is obvious that if the pulley on shaft A is not on "square" the cord may not be at exactly right angles with the shaft. It is therefore always advisable to rotate the pulley and try the cord in several positions. If the pulley wobbles the cord will indicate various locations for the pulley on shaft B. In that event, if the pulley on shaft B cannot be set square the "mean" position is the correct position for the pulley on shaft B. That is, locate the pulley at the mid-point between the two extremes.

Of course you must make certain that the shafts are parallel. Unless the shafts are parallel all of the above work will be of no avail. If they are not parallel, make them so.

Another method employed in installing machinery that is entirely too common is to simply "sight across" from pulley to pulley or sheave to sheave, place the machine at approximately the desired spot, and then shift the machine by the cut and try method until the belt stays on the pulleys or sheaves. Simply because a belt stays on the pulleys or sheaves isn't proof that the pulleys or sheaves are accurately aligned. Nor is it true of chains on sprockets. A tight belt on crowned pulleys will offset considerable misalignment. The belt will "stay on" and the drive will "look" all right, but the belt won't be able to do its best. It is better practice to first align the pulleys accurately. Then the belt needn't be operated so tight. The belt will pull more, will operate more efficiently, and will last longer.

Eliminating Vibration In Reciprocating Machinery

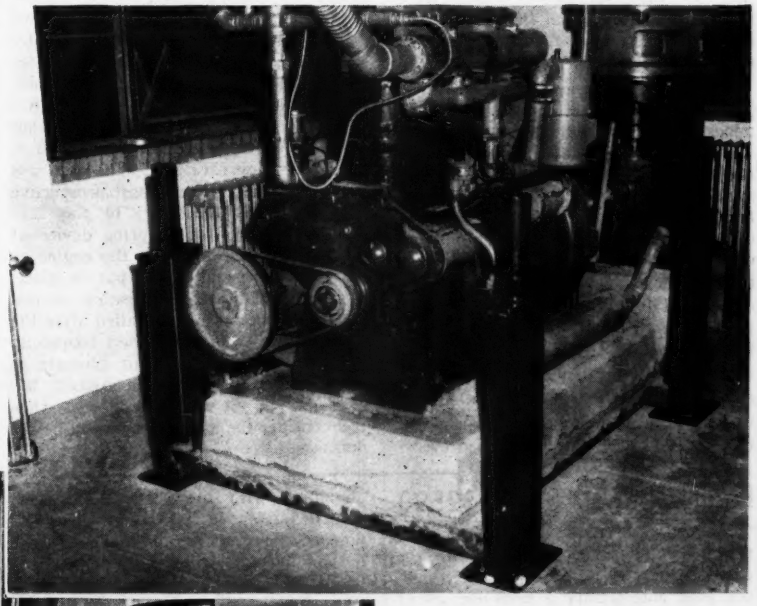
By JOHN E. HUBEL

ATTEMPTS to eliminate vibration in reciprocating machinery have been made ever since the first engines—no matter what type—were put on the market. Among the attempts to cut down or eliminate noise and vibration in machines have been the installation of rubber hose in pipe lines leading from the offending equipment; placing the machine on rubber or other material which was expected to take up some of the vibration, and other methods, most of which were temporary in the solution of the problem, if such devices or method helped at all. Diesel engines, while not being the worst offenders in the production of vibration and noise, have brought problems of their own along these lines, probably due to the high pressures used, or for other reasons.

Some very effective methods of eliminating the vibration have now been in use on Diesel engines, and other heavy machinery such as air compressors, steam engines and drop forge machinery. Diesel engine installations have been made vibrationless, as have other types of machinery, by the installation of spring devices, as illustrated, known as Korfund vibration control. In the case of the Diesel engine shown in Fig. 1, which is used for auxiliary service, the user claims that this spring device, specially designed for the purpose, was found to be the only satisfactory solution of the problem of isolating this engine; in fact, persons formerly complaining of the vibration from this machine advised, after the vibration control had been installed, that they did not know the engine was in operation.

Figure 2 shows a Diesel engine of 150 hp, being a 4-cylinder machine, with a different type of vibration control than the one shown in Fig. 1. This larger Diesel had been originally installed in connection with a generator in a large laundry, and no vibration control had been thought necessary. Due to bad subsoil conditions, however, complaints regarding vibration began coming in, and a rather serious problem arose. If this condition had been known in advance, it would have been a simple matter to install the engine on an isolated concrete base to provide inertia mass but after the engine was in place such a special base could not be provided. It is claimed by this user that the vibration control used was the first of its kind ever applied to such a large Diesel, as it had been of the kind tried only on smaller engines of the single cylinder type.

In this case, fortunately for the company operating the Diesel-electric equipment, both the engine and generator had originally been installed on an integral steel sub-base, which permitted the installation of the vibration control under the engine base. It was quite a simple matter to raise this sub-base sufficiently to insert transverse steel channel irons with the Korfund vibration isolators welded onto each end. This permitted the resilient mounting of the engine to eliminate transmission of vibration through the concrete floor. While this would have solved the problem for a 3, 6 or 8-cylinder unit, it still did not control the action of the 4-cylinder secondary free forces, the effects of which would then have been accentuated by the resiliency of the spring mountings to cause excessive engine motion even though no vibration could reach the floor



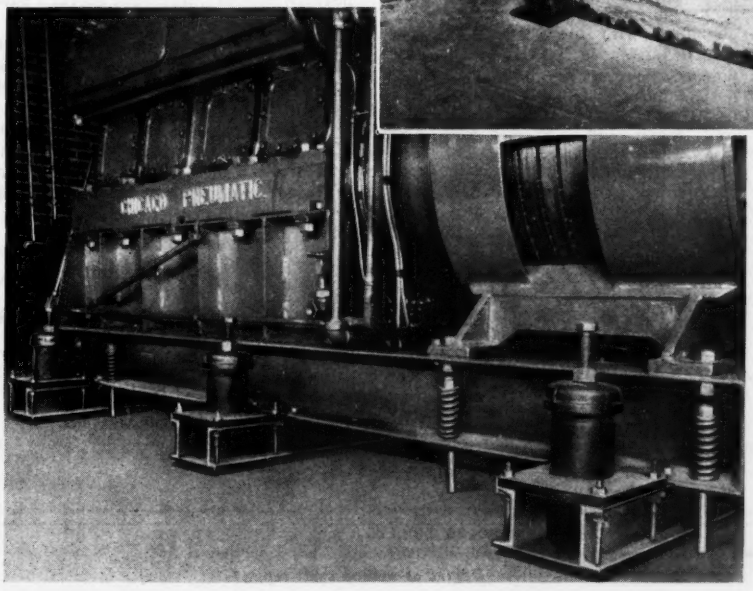


Fig. 1. (Above) This spring device, designed especially for supporting this engine, was found to be the only means of isolating this engine. The engine virtually hangs on spring supports

Fig. 2. (Left) Vibration control for a 150 hp, 4 cylinder Diesel engine generator. Vibro-stabilizers were necessary here in addition to vibration isolators because of the secondary free forces of the 4-cylinder engine

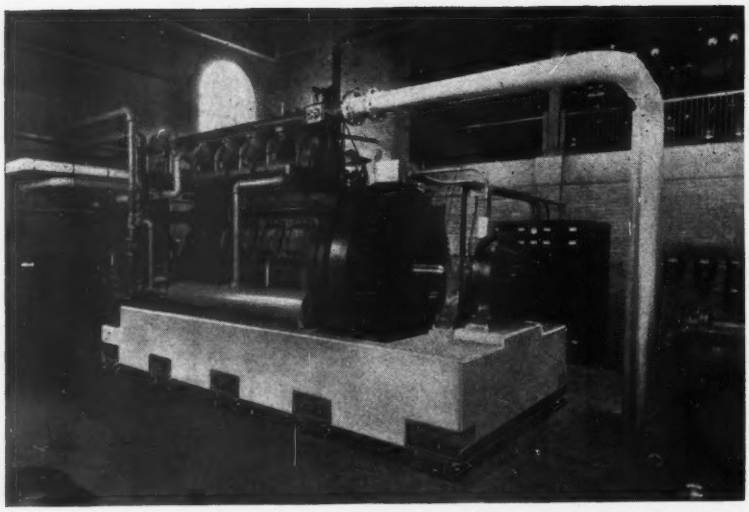


Fig. 3. Vibro-dampers on the 5-cylinder, 300 hp, 500 rpm gas engine generator at the Peoria, Ill., Sewage Disposal Plant

or surrounding buildings. This condition was satisfied, however, by the installation of Vibro-stabilizers, which were anchored to the original foundation bolts in the concrete floor and provided the necessary restraint to vertical movement.

Vibration from heavy machines has been transmitted from basements to upper floors of buildings in freakish ways, according to an engineer who has made a study of many complaints from such sources. In some instances, we are told, the vibration can be felt on all floors of a many-storied structure; in other cases the complaints will come only from certain floors above the offending machinery. The reason for "jumping" certain floors or parts of buildings is not known, as piping from the machinery or steel work of the structure will be found to be continuous through all of the floors of buildings. Some tenants, learning that the power plant engineer has tried everything he knows of to eliminate the vibration, have tried to get rid of the nuisance locally by placing radiators on rubber and bracing certain exposed piping with rubber, but usually of no avail. However, where the patented devices described have been installed, the complaints have been found to cease promptly. Now engineers, knowing that vibration can turn up in any installation, no matter how carefully planned in advance as to foundation, advise prospective users of heavy machinery to play safe and install an effective spring device of the kinds described before the engine or other heavy machinery is put in place. Many installations of vibration control have been successfully installed after the machinery is in operation, but frequently it is necessary to chip out concrete to accommodate the vibration control, but even that is not excessive in cost when you consider the annoyance caused by the nuisance.

Engine Repair Saves $2590

EVERY OPERATING engineer at one time or another is confronted with the problem of either junking some worn-out part and getting a new one or of repairing it. Repair, in many instances, involves a lot of work and a certain kind of courage but if successful the result provides a source of satisfaction and often saves considerable money.

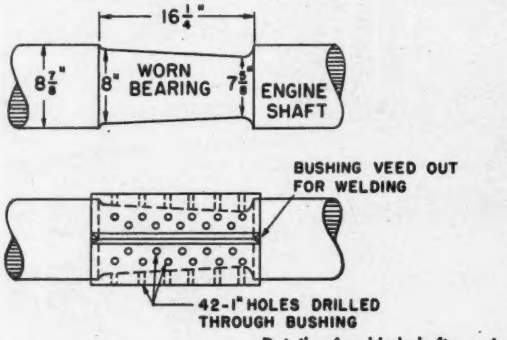
An interesting account of such a repair is that given here by Henry Leopold, Superintendent of the Southern Extract Co. at Knoxville, Tenn. This involved the repair of a worn shaft bearing for a 400 hp twin engine. As shown in the accompanying sketches, this shaft was reclaimed by casting a steel sleeve and welding it to the worn shaft. After the casting was made, painstaking measurements of all parts of the shaft to be repaired were taken and the casting was machined to allow a ¼-in. overlap on the true shaft and beyond each end of the worn area, thus insuring perfect alignment with the shaft. The shell was then split in half lengthwise, "V" notched along the splits to be rejoined by welding and drilled with 42 one-inch holes for anchor welding to the worn area.

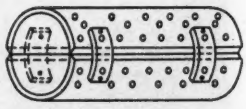
To hold the bushing in place during the welding, straps were made by casting a 4 in. wide, 9 in. bore (outside diameter of the bushing) iron ring. Four 6-in. segments were then cut from the ring to make straps which would have the same radius as the outside diameter of the bushing, to insure its having perfect alignment when strapped into place. The straps were held down by dowel pins and cap screws.

When the bushing was ready to be attached, the engine was shut down and blocked to hold the shaft in position, the bearing blocks were removed and the bushing secured in place by the straps and welded along the "V" groove. A three hour cooling period was then allowed for shrinkage. The 42 one-in. holes were then welded up and to the shaft to anchor the bushing. After the welding was completed, the surfaces were rough ground with a hand grinder and smooth finished with a file. The bearing blocks were then re-babbited and the engine assembled. The work was done without the 36-in. 2-ply belt being removed from the pulley.

The entire job was done by three men and the engine was out of service for only 36½ hr. About 30 lb of ⅛-in. welding rod were used and the total cost for material and labor did not exceed $210.00. Cost to purchase and install a new shaft would have been approximately $2800.00 and the engine would have been out of service for at least a week.

Since the repair job reported above, done about 5 months ago, the shaft has been in operation twenty-two hours per day and has given no trouble at all.





Details of welded shaft repair

Recharging Dry Cells

By Edmund J. Bonnet

HERE IS a little trick that may or may not be known to others but I have found it useful, especially these days when dry cells are hard to get. It concerns a method of recharging dry cells when they are worn out. Here is the way it is done:

1. Place center post of dry cell on positive pole of automobile storage battery.
2. Connect a wire to ground or negative post of automobile battery.
3. Run this wire to the casing of the dry cell.
4. Remove when dry cell gets warm.

This operation requires 4 or 5 min. The dry cell is then ready for use and may last from 3 to 6 hr in use after which it can be recharged again.

Imprinted Sheets For Engineering Drawings

By FRANK P. KUHL
Chief Draftsman,
Consolidated Edison Company of New York, Inc.

AN ENGINEERING drawing usually has some form of title and change block and, in many instances, a border line. Where a quantity is used, imprinted sheets represent a definite saving in handwork and a uniformity of appearance.

To determine the most economical sizes for a series of imprinted sheets and a method of indicating changes and revisions, a study of existing practices and standards was made, which revealed a wide variance in details.

Sheet Sizes

This study indicated that the standard letter size of 8½ by 11 in. might be used as a basis for determining a series of sheet sizes. Prints folded to these dimensions could then be filed together with correspondence, or filed separately, in standard letter files. Multiples of 8½ by 11 inches seemed to suggest a series of 11" x 17", 17" x 22", 22" x 34", and 34" x 44", each successive sheet size being twice the area of the preceding one. However, this did not prove economical, as the widths of standard rolls of tracing cloth, tracing paper, blue print paper, etc., progress in multiples of six inches, usually beginning at 24 in. On this basis, a 34 in. wide sheet would have to be cut from a 36 in. wide roll, thus wasting 2 in., or 5½ per cent, of both drawing and reproduction paper or cloth. A roll 30 in. wide (which dimension usually runs from ¼ in. to ¾ in. greater for both paper and cloth) resulted in a series of 30" x 44", 22" x 30", 15" x 22", 11" x 15", and 8½" x 11". The last is a standard letter size sheet and is readily obtainable in cut form. Each sheet size was identified by a letter, the letter "A" being assigned to the largest because it was most commonly used and should be easily remembered by the draftsman. The successively smaller sizes were designated "B", "C", "D", and "E", respectively. The final folding size of prints from these sheets is 7½ in. by 11 in., which is suitable for filing in letter size cabinets, together with correspondence, and does not require accurate folding in order to remain within the limits of a standard size letter. The "D" and "E" size sheets are primarily intended for use in letter size binders.

Title Blocks

Each sheet was provided with two title blocks, the main block being placed in the lower right hand corner and the auxiliary block in the upper left hand corner.

The auxiliary block was placed in an inverted position, containing only the drawing number and a short title, to be used primarily for filing purposes, to eliminate the wear and tear that the main title block usually is subjected to from fingering when looking for a drawing in a plan file. This fingering eventually causes the tracing fibres to break and accumulate dirt and, when reproduced, the image on this area of the drawing is either hard to read or entirely unreadable. The drawing, when filed, is placed in an horizontal plan file with the auxiliary block in the front of the drawer and on the right hand side.

The drawing number in the main title block was located so that it appears on the front of a folded print in the upper right hand corner with the title immediately underneath it. This makes the folded print suitable for filing in a standard letter file and eliminates the usual practice of transcribing the number and title to the outside of the folded print, as shown in Fig. 1. The method of folding prints is shown in Fig. 2.

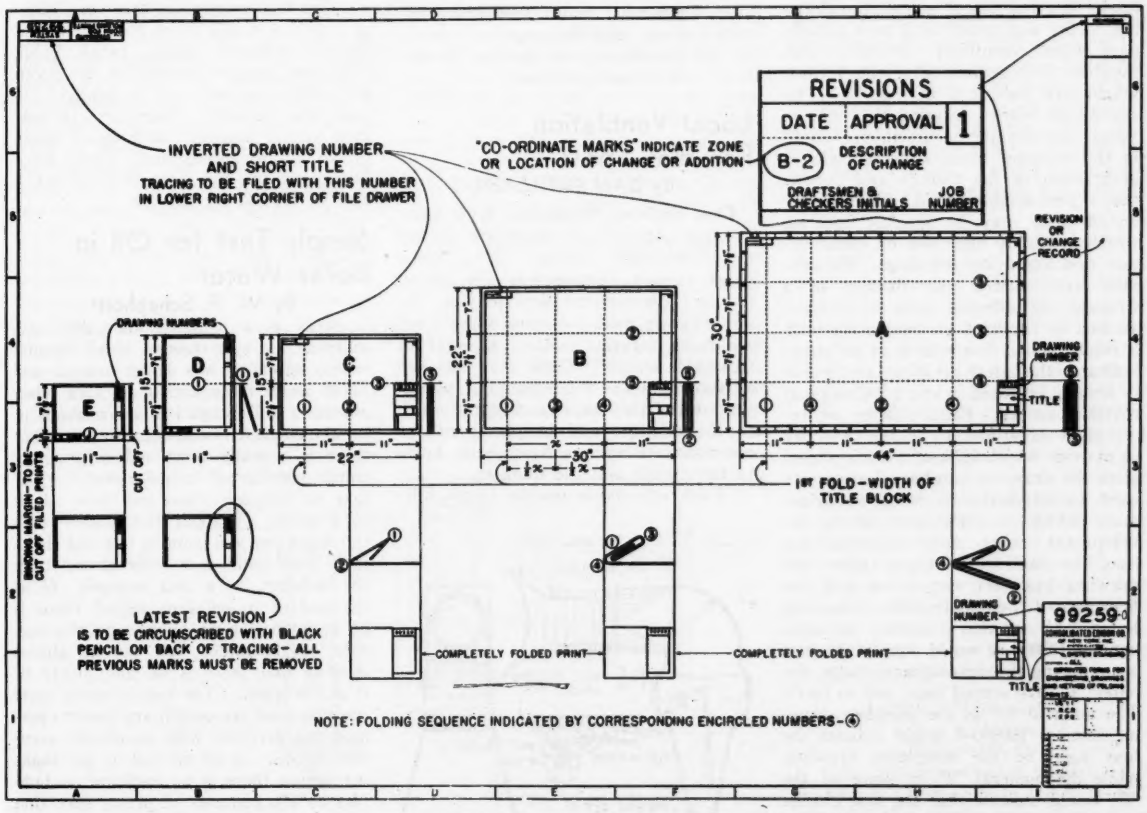

REVISIONS
DATE
APPROVAL
1
B-2
DESCRIPTION OF CHANGE
DRAFTSMEN & CHECKERS INITIALS
JOB NUMBER
INVERTED DRAWING NUMBER AND SHORT TITLE
TRACING TO BE FILED WITH THIS NUMBER IN LOWER RIGHT CORNER OF FILE DRAWER
"CO-ORDINATE MARKS" INDICATE ZONE OR LOCATION OF CHANGE OR ADDITION
REVISION OR CHANGE RECORD
DRAWING NUMBER
TITLE
DRAWING NUMBERS
BINDING MARGIN - TO BE CUT OFF FILED PRINTS
CUT OFF
1ST FOLD - WIDTH OF TITLE BLOCK
LATEST REVISION
IS TO BE CIRCUMSCRIBED WITH BLACK PENCIL ON BACK OF TRACING - ALL PREVIOUS MARKS MUST BE REMOVED
COMPLETELY FOLDED PRINT
COMPLETELY FOLDED PRINT
99259
NOTE: FOLDING SEQUENCE INDICATED BY CORRESPONDING ENCIRCLED NUMBERS - ④

Fig. 1. Imprinted sheet, showing title blocks, coordinate-marked border, revision block, and method of folding prints

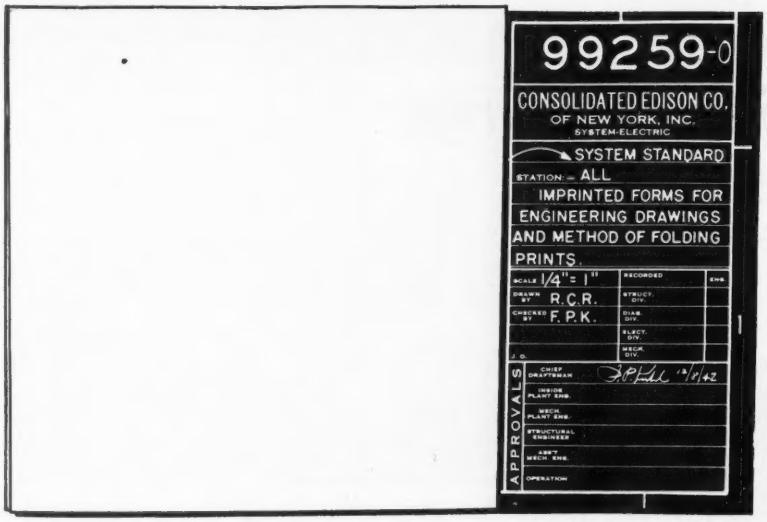


Fig. 2. Folded blue print, suitable for filing without the necessity of transcribing drawing number and title to outside of print

Revision or Change Block

The revision or change block was placed at the extreme right of the sheet, running from the top to the main title block (Fig. 2). This location makes it unnecessary for the draftsman to rest his hand on the body of the drawing while making notations and avoids soiling.

Method of Indicating Changes

To eliminate the arrow and number method of indicating changed areas, a border line was placed around the drawing. This was subdivided into coordinate zones identified vertically with numbers and horizontally with letters, which are indicated in Fig. 2. The coordinate marks, locating the zone in which the change occurred, are noted in the revision block together with a description of the change and constitute a permanent record. Thus an affected area may be quickly located, which is highly desirable on construction and assembly drawings. To simplify still further the finding of a change, the affected area is circumscribed on the back of the tracing with a heavy pencil line which at all times indicates the latest revision, and which is always removed when a subsequent revision occurs. Each change or revision is identified by either a letter or number which follows a dash placed after the drawing number. Letters are used to eliminate an issue of prints made while the drawing is in the development stage and numerals are used to indicate changes after the drawing has been completed and has been issued for construction. Thus the letter "A" in the complete drawing number 100000-*A* would signify the first issue during the development stage, the letter "B", the second issue, and so forth. The numeral "0" in the complete drawing number 100000-*0* would indicate the first issue of the completed drawing, while the numeral "*1*" in place of the "0" would indicate that the first change or revision had occurred after the completion of the drawing.

To summarize, these details, while seemingly inconsequential, do really add much to the appearance and better use of the products of the drawing room. They simplify the eventual handling of prints by:

(1) Allowing the folded prints to be filed without transcribing the number and title to the outside of the print
(2) Providing clarity of drawing numbers and titles on prints from aged drawings
(3) Simplifying the finding of revisions and changes.

Local Ventilation For Hot Spots

By DAN GUTLEBEN
Chief Engineer, Pennsylvania Sugar Co.

THE LACK of air movement around the "centrifugal station" in a syrup plant caused considerable discomfort to the operators. After studying the situation we finally ordered some fresh air ducts together with a number of adjustable outlets. These were installed as shown in the accompanying photographs and they have contributed much to the comfort and happiness of the operators. Branches have been made to the melter and the mingler.

Each adjustable nozzle (duck bill) delivers the fresh air to the spot where the operator wants it and provides a sufficient volume of air to push the surplus room heat and moisture out of the way. It brings outdoor conditions into the room. The nozzles are located rather low instead of being placed at the ceiling because the air here is cooler and the fresh supply at the lower level pushes upward so that it moves in streamline manner through the ceiling or window openings. When the nozzles were located in the hot zone at the ceiling, the hot air that was on its way out was stirred up and brought back down again.

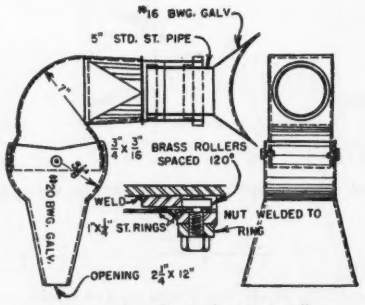


Fig. 1. Details of the duck bills

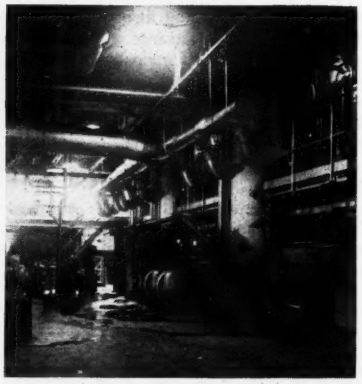


Fig. 2. View showing the ventilating system installed

Cost

The fan supplying the ventilation is a No. 4 single inlet blower with a direct connected motor, rated 3 hp, 1160 rpm, located outside of the room and delivering into a 21 in. header. Its cost was $212.00. There are 12 six-inch swivel nozzles (duck bills) made of No. 20 galvanized steel. These were fabricated by our own tinsmith at a cost of $293.42 for the lot.

Simple Test for Oil in Boiler Water

By W. F. Schaphorst

HERE IS a valuable kink that was given to me by a former chief chemist whose specialty was boiler waters and boiler water treatment. I am sure other engineers will be glad to know about it.

My chemist friend informed me that there is a really good and surprisingly simple test for oil in boiler water. Just take an ordinary clean test tube, fill it to a depth of about two inches with the feedwater you want to test and shake it in your hand with your thumb over the opening for a few minutes. If at the end of a sufficient period there is an accumulation of bubbles on the surface of the water you can be almost positive that there is oil and plenty of it in the water. The test is really quite sensitive, and one which any boiler operator can perform with amazingly accurate results. If at the end of the shaking period there is no evidence of bubbles at all, you can be pretty sure that the amount of oil in the water is too little to cause any harm.

How Would You Do It?

PROBLEM 29. ELIMINATING MOISTURE FROM A PAINT SPRAY COMPRESSED AIR LINE

PROBLEM 29, propounded by Our Hero in the July issue, was simple in its fundamental aspects, yet because of the conditions laid down its practical solution demanded a certain degree of ingenuity, considerably more than Our Hero seems to be able to produce. He is somewhat of a dope. In ordinary times, the problem could have been disposed of simply by going out and buying a separator of some kind and installing it in accordance with the manufacturer's instructions but there happens to be a war going on just now and things are less simple than they used to be. Strangely enough, even the Board of Judges had no particular trouble in understanding the problem and they disposed of it with an abandon that was unbecoming of their judicial dignity. One of the old fellows insisted that all that was needed was an umbrella somewhere in the system; that, he claimed, would keep the rain out.

Although a number of methods are available for removing moisture from compressed air, in this particular case only the simplest method need be used. This may be called the velocity baffling method since it involves a sudden change in direction of the moisture laden air by baffles or alternative means. Moisture can be removed from air by cooling, by water or refrigeration or by chemical dehydration but these methods involve complexities which are not warranted in the case under consideration. For the purpose required, it is not necessary that the air be 100 per cent moisture free, all that is required is the removal of the moisture suspended in the air.

This calls for a separator of some kind. If, at the same time, the air is cooled to a point under saturation, moisture removal will be even more effective.

Nearly all of the solutions submitted made use of a separator of some kind. Some were more elaborate than others, but the principle in all was essentially the same. Two contestants recommended the use of heaters. While a heater would tend to reduce the entrained moisture in the air, a heater alone would not eliminate the moisture. When air is heated, its ability to hold moisture is increased, hence, if there is any condensate in the line, the heated air would take up this moisture and as a result would actually increase its moisture content. If the air were cooled first and then heated, the result would be much more effective.

Insofar as the design of the separators were concerned there was little to choose from in the solutions submitted. Many of them used identical principles and nearly all of them would work. There was some difference in the sizes but size is not a critical factor in the design of these separators. The first prize, however, was awarded to W. H. O'Connell not only because of his fine detailed drawing (shown in Fig. 1 just as submitted) but also because of his short and effective description of the device he proposes.

The second prize was awarded to Thomas W. Benson for his originality in working out an arrangement which utilizes both velocity baffling and cooling in the same device. His whole attitude indicates a real interest in the problem and his analysis of the situation is excellent.

Our friend, Julian Calvert who upon several other occasions has knocked down awards in these contests was given the third prize award because of his excellent discussion of all the factors with which this problem is concerned. It will be noted that Mr. Calvert lists all the methods by which moisture removal can be effected but he recommends the use of a baffle type separator combined with some cooling of the air.

The prize winning letters follow:

FIRST PRIZE AWARD
W. H. O'Connell
Phillipsburgh, New Jersey

It behooves Our Hero to install both a moisture condensate trap and moisture condensate filter at the spray-room end of the 500-ft air line from his engine room.

It is entirely practical for Our Hero to make this equipment from standard

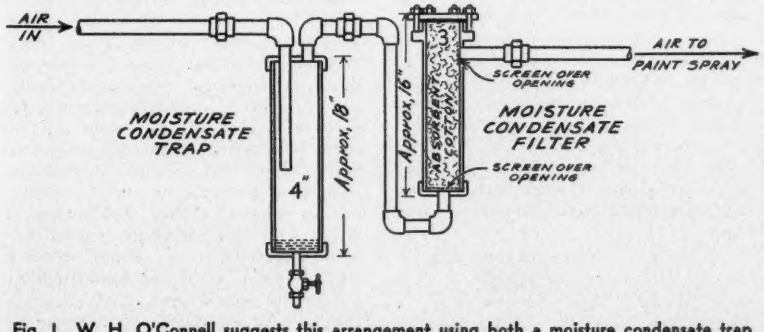


Fig. 1. W. H. O'Connell suggests this arrangement using both a moisture condensate trap and a moisture condensate filter

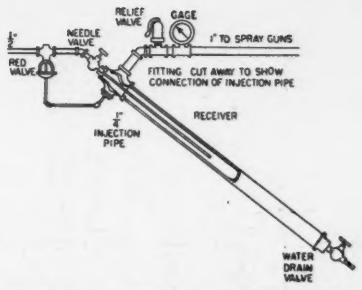


Fig. 2. The combination cooler and moisture trap of Thos. W. Benson

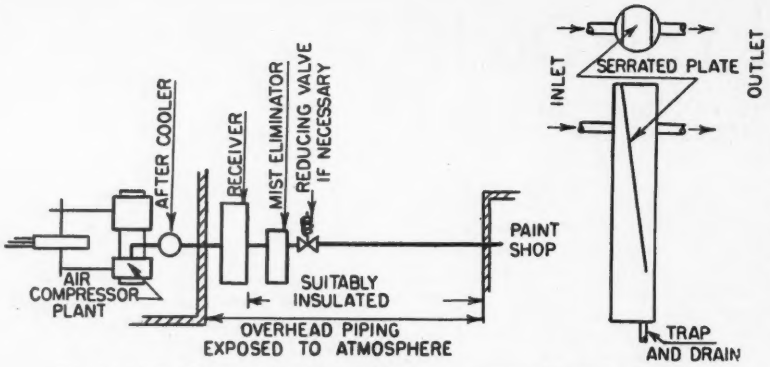
pipe and pipe fittings, with the addition of a little machining and welding. Many commercial moisture condensate traps are little more than assemblies of this nature. His moisture filter may be a little crude in comparison with a commercial unit but this should not detract from its efficiency.

As shown on the accompanying sketch, the compressed air should first pass through a moisture condensate trap. This is nothing more than a vertical cylinder provided with inlet and outlet for the air at the top, and a petcock at the bottom for draining condensate which collects in the cylinder. Although most of the excess water in the air should be removed by the intercooler and aftercooler of the compressed air plant, the evidence as stated in Problem 29 indicates that additional condensation is taking place on the 500-ft air line. The moisture condensate trap will collect the bulk of this water traveling along the line. It is necessary, of course, for someone to drain the moisture condensate trap periodically. This is a task taking only a few moments' time and, while very little water collection will be noted on dry days, it is good practice to open the petcock and drain whatever has collected *every single day.*

Some of the moisture condensed in the pipe and in the condensate trap itself will re-enter the air stream not as water vapor but as a mist fine enough to be carried by the air stream. One of the simplest ways to remove this non-vaporous moisture is to pass the air through a chamber filled with highly absorbent cotton. Air should enter this chamber or drop leg at the bottom and leave at the top as indicated on the sketch. It will be more convenient to replace the cotton (as will be necessary from time to time) if the discharge pipe is at the side of the cylinder just below the top plate which becomes the cover. Our Hero will probably use 3-in. pipe for the filter drop leg, and, with 18 psi, six stud bolts securely welded to the outside of the pipe won't be too many to hold the cover plate and gasket securely.

SECOND PRIZE AWARD
Thos. W. Benson
Philadelphia, Pa.

The problem presented by Our Hero involves a bit more than the mere construction of a simple form of air dryer employing the usual silica gel or calcium



Figs. 3 and 4. This simple baffle type eliminator is suggested by Julian P. Calvert

chloride. At least I would consider it in another light and find another answer.

Take the matter of the air pressure, some 180 psi. To me this seems entirely too high and might possibly cause some of the trouble as I understand it has not definitely been proved that moisture alone is the trouble.

It would be a simple matter to connect a gage in the air line to a spray gun and by means of a hand throttled valve determine if some lower pressure would not give better results. It is my opinion that it would be found possible to turn out satisfactory work at pressures between 20 and 40 psi. And that might be the answer to the whole problem.

However let us assume that it was found practical to use lower air pressures and the moisture factor still caused trouble. I certainly would want to use the lower pressure for reasons of economy and would devise a combination of receiver, reducing valve, relief valve and gage to give the optimum spraying pressure. And by a little care in assembly this apparatus could constitute air cooler and what I am pleased to call velocity moisture trap.

The sketch (Fig. 2) shows the usual assembly of apparatus to provide the source of lower air pressure. The receiver may be any available vessel capable of standing the pressure desired, a hydraulic test being made to be certain of the fact with a margin of safety. Even a length of 2 or 3 in. pipe would do the trick very nicely if obtainable.

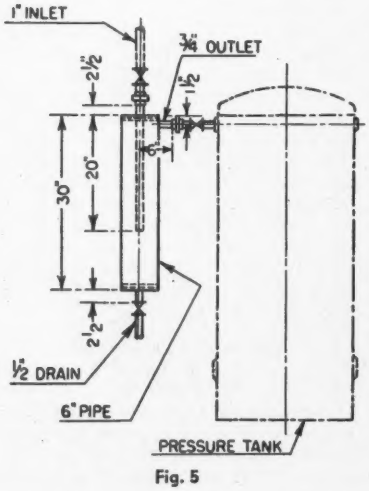


Fig. 5

The connections to the receiver of the relief valve and gage can be made by any combination of fittings on hand. The important points in the assembly being to have the needle valve mounted immediately on the intake to the receiver and a pipe from the valve running half way down the receiver. The latter pipe is open ended, appropriate sizes being given in sketch.

If a length of pipe is used for the receiver it should be mounted at an angle with provision for draining water from the lower end. Other receivers should be mounted vertically also arranged with drain.

After connecting the assembly it is put into operation by adjusting the reducing valve to give the desired pressure with the needle valve wide open. With the spray apparatus working the needle valve is slowly closed till it is heard hissing with the air flowing through it. The needle valve is then adjusted so the lag in response of the reducing valve is not sufficient to cause the air pressure to drop too low when spray guns are operated.

Just what results I would expect from this arrangement might still be a puzzle. The first effect of the equipment is to cause the major expansion of the air to take place almost in the receiver itself. This is due to the presence of the needle valve and should be accompanied by a reduction in temperature of the air according to the laws of expanding gases. This should cool down the incoming air and precipitate some of the moisture.

The air discharging from the end of the small pipe in the receiver will impart a certain velocity to the moisture particles spraying them onto the walls or bottom of the receiver while the air itself flows in a reverse direction to the discharge outlet. The cooling action may be helped by covering the receiver with asbestos pipe covering or some similar heat insulator.

So in one action we get additional air cooling and velocity separation of moisture. Maybe it won't suit Our Hero but I would give it a try if faced with this problem.

THIRD PRIZE AWARD

Julian P. Calvert
Flushing, N. Y.

The problem requires the delivery of air at 180 psi in the paint shop without free moisture, suspended droplets of water, and to provide a margin of safety it would probably be desirable to supply it undersaturated at 80 to 90 per cent relative humidity. Since the line is overhead and the paint shop is about 500 ft away it is reasonable to assume that the line is exposed to atmospheric temperatures.

Available methods of conditioning air include the following:

1. Water cooling
2. Refrigeration
3. Chemical dehydrating agents
4. Compression and cooling.

Water cooling would involve cooling the air directly with a spray or indirectly with a shell and tube condenser. Either salt or fresh water would be suitable.

Refrigeration would be carried out by contacting the air with a chilled spray of a suitable liquid, such as water, brine, oil, or passing the air through condensers cooled by a circulating medium.

Chemical dehydrating agents are widely recognized for water removal from air. The chemicals used are a hygroscopic solution of brine, calcium chloride, glycerine, or a combination of these. All may be used again after removal of removed water. Silica gel, and Fuller's earth, although not a chemical agent, may also be used for dehydration and may be reused after regeneration.

Compression and cooling is carried out by a predetermined amount of compression above line pressure, cooling under pressure with removal of condensate, and expansion to line pressure with consequent undersaturation.

Of the methods outlined above, water cooling, refrigeration, and the use of chemical dehydrating agents involve the purchase and installation of equipment, would require constant attendance, and on this basis they would not appear to be attractive. Compression and cooling however, could be accomplished with a minimum of equipment, and would not require attendance once the proper operating procedure was established.

Figure 3 shows a line diagram of the proposed installation.

No changes are proposed in the existing arrangement until after the receivers, which are located outside the engine room and presumably not insulated, and would offer the advantage of some atmospheric cooling. Figure 4 shows the general arrangement of a mist eliminator which should be installed just after the receivers. This can be made up of available material and the dimensions are not critical. The principle involved is separation of entrain moisture by reduction in velocity, baffling, and change in direction of flow. Moisture removal can be accomplished by periodically blowing out the water or by the installation of a float type trap.

The required degree of undersaturation should be determined by experiment

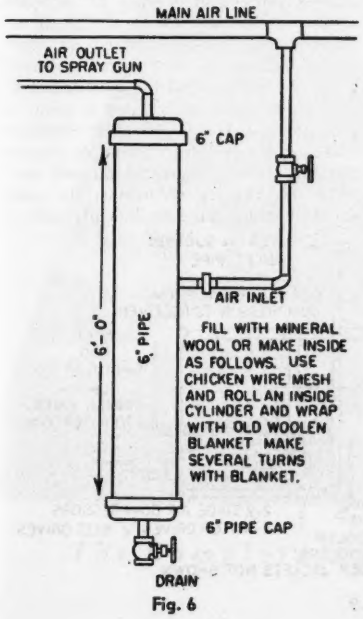
but probably not more than 20 lb compression above the 180 lb required at the paint shop would be sufficient. The pressure reduction can be accomplished either by a pressure reducing valve or perhaps the line pressure drop from the receiver to the paint shop is of this order in which case the pressure reducing valve may not be needed. In any case the pressure reduction must occur in the largest part between the outlet of the mist eliminator and the paint shop.

The mist eliminator, pressure reducing valve, and piping to the paint shop should be suitably insulated.

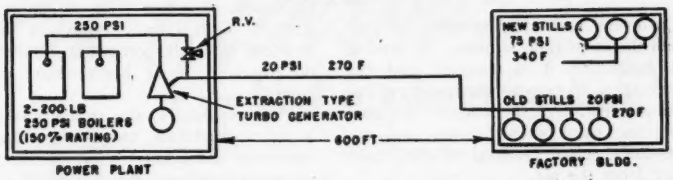
Honorable Mention

Honorable mention is accorded to a number of contestants who submitted workable arrangements to solve Our Hero's problem. Among these are M. H. Rettig of Fort Wayne, Ind., Charles Lybrink, Maintenance Foreman of the Dearborn Glass Co., Chicago, Ill., Thomas R. Read of Pittsburgh, Pa., David Sommerville of Pittsburgh, Pa., William F. Rainer of Hawthorne, N. J., L. Rusch of Glenham, N. Y., and William N. Stevenson of Pontiac, Michigan.

Mr. Rettig's solution makes use of the simple water separator shown in Fig. 5. Quoting from his letter, "I am enclosing a drawing of a water separator which we have used for a number of years for the elimination of water or moisture from air lines to a pressure tank used with our system. This may be made from any size pipe in proportion to the one shown in the sketch (Fig. 5). No expensive materials or equipment are required to assemble one of these; any welder can assemble it in a few hours from scrap material found around any plant. To indicate the amount of water that collects in the separator a gage glass may be installed on the side as near the bottom as possible. The accumulated water should never be permitted to cover the end of the inlet pipe since this would defeat the purpose of the separator."


MAIN AIR LINE
AIR OUTLET TO SPRAY GUN
6" CAP
AIR INLET
6'-0"
6" PIPE
FILL WITH MINERAL WOOL OR MAKE INSIDE AS FOLLOWS. USE CHICKEN WIRE MESH AND ROLL AN INSIDE CYLINDER AND WRAP WITH OLD WOOLEN BLANKET MAKE SEVERAL TURNS WITH BLANKET.
6" PIPE CAP
DRAIN
Fig. 6

Problem 30
THE PROBLEM OF THE HIGH PRESSURE STILLS



Our Hero is on the spot once more. This time he is up against the problem of supplying a group of three new stills in the factory with steam at a higher temperature than that which has been used in operating the existing stills. The arrangement is as shown in the diagram above. As will be noted the existing stills were supplied through a 600-ft line carrying steam at a pressure of around 20 psi and a temperature of around 270 F. This steam is obtained partly from an extraction stage on the turbine and partly from the high pressure steam through a reducing valve. Now, a new battery of stills has been installed which call for steam at a temperature of 340 F. The new stills will require on the average of 1000 lb of steam an hour. The existing 20 lb steam line to the factory is of ample capacity to carry the additional steam but Our Hero's problem is to raise the temperature of the steam to the 340 F needed by the new stills. The specifications call for steam at 75 psi and 240 F. Since the temperature is the factor of primary importance, Our Hero's first impulse was to install a small separately fired superheater but because of the above mentioned specifications he is not sure that merely superheating the steam would work. Of course, he could install another steam line from the power plant supplied through a separate reducing valve, but that is a rather expensive proposition and piping is hard to get. Other things have occurred to him but he is still uncertain as to just what to do. He has even thought of an electric boiler. Who can help the poor guy out? Suppose you were in his shoes, what would you do?

Send us your solutions to this problem in a letter of not over 1500 words by September 30. A $25.00 war bond will be awarded for the best solution. A second prize of $10.00 will be awarded for the second best solution and a third prize of $5.00 for the best third. Entries in this contest should be marked Problem 30 and should be addressed to the Contest Editor, Technical Publishing Co., 53 W. Jackson Blvd., Chicago 4, Ill.

Charles Lybrink submits a somewhat similar arrangement, but he fills his with glass wool. "Sometime ago," he writes, "I had a similar problem to solve as Our Hero. I assembled an air cleaner using a piece of common 4-in. pipe 24 in. long in a manner shown in my sketch, and attached this to the air line close to the spray booth. I packed the 4-in. pipe tight with glass wool, placing two disks of common window screen in each of the 4 by ¾-in. reducers to prevent the glass wool from entering the outlet. We have been using three of these contraptions; one near each spray booth, for the last six months, and find that the air at the spray gun is free from moisture and dirt. They give very satisfactory results."

Thomas R. Read's letter showed how he made an air filter for his paint shop for the same purpose as that required by Our Hero. This filter, he points out, can be made by any pipe fitter or mechanic. As shown in Fig. 6 it is made of a piece of 6-in. pipe, 6 ft long, and two 6-in. pipe caps. Fill the pipe with mineral wool or roll an inside cylinder of chicken wire about 5-in. in dia and wrap with an old wool blanket. Make the inside cylinder the full length of the 6-in. pipe so the air will filter through the blanket. The blanket will take up the moisture and this will then drip to the bottom of the cylinder.

Wm. F. Rainer's solution is similar to the one just described except that his pipe is merely filled with fiber glass, rock wool or wood shavings. He, however, uses only a two inch pipe for his filter which might not be large enough if a large amount of air was used. "Of the three materials suggested for use in this filter," writes Mr. Rainer, "fiber glass will probably be the best. The fiber glass will enable the moisture to condense and flow to the bottom of the two inch pipe." While Mr. Rainer's device would filter out the moisture it seems that he could improve his design if he did not place the inlet and outlet lines exactly opposite each other.

A solution, using a different idea from those just described is that submitted by David P. Sommerville. "I believe," he writes, "Our Hero can solve

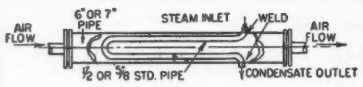


Fig. 7

his problem best by preheating the air which the paint shop is using. In making this suggestion it is assumed that the specification 'to remove the moisture' can mean elimination of the moisture nuisance from the paint shop process and not necessarily actual removal of the water vapor from the air.

"Possibly, the paint shop's air expansion is more adiabatic than isothermal. The moisture holding ability of any gas is determined by its pressure and temperature, especially the latter. In this case, the rate of temperature drop is greater than the rate of volume increase, and, consequently, the excess vapor is condensed. Kent's Mechanical Engineers' Handbook points out that the moisture capacity of air is halved by every 20 F drop in temperature. Also, the capacity for moisture doubles as the air volume doubles.

"On the other hand, the moisture nuisance may be caused by cooling of the saturated air as it moves through the 500 ft pipe line after the receiver. In this case, the condensate is not settling out but is being carried in suspension as a fine mist. This, of course, is due to the velocity of the air in the pipe line.

"In either case, heating the air will effect a permanent and positive cure. In normal times, the writer would simply install a Griscom-Russell Co. No. BSS-124 Twin G-Fin heat transfer section and use exhaust steam as the heating medium. 'Our Hero' can qualify for such a section if any of his painted products are sold for defense purposes. Apparently, this is not the case so the use of a 'Hair-pin' bend, homemade type of exchanger, is the next best bet. The exchanger would consist of an enlarged section of pipe fitted with several U-bend heating coils as sketched (Fig. 7):

"The use of a U-bend coil will automatically take care of expansion and contraction. The coils can be built of standard fittings and should contain not more than 10 to 12 sq ft outside transfer surface."

While drying the air by heat as suggested by Mr. Sommerville would evaporate whatever moisture might be entrained in the air in the form of droplets, this method would not necessarily provide dry air. If pre-cooling and condensation were used before the heater, the system would be much improved.

Such a system of pre-cooling was suggested in the solution submitted by L. Rusch, shown in Fig. 10. Says Mr. Rusch, "Our Hero's relatively simple problem is made somewhat difficult by the need of using home made equipment.

"As supplied to the sprayers, the air is at a moderate temperature and at saturated dew-point. That is the point we must eliminate, the dew-point. It is this dew-point that is not resulting in moisture formation.

"The moisture in the air could not exist without its mother, Wet Condensation. Mother Wet Condensation could not exist without Grandmother Dew-point. Grandmother Dew-point could not exist without all of her 100 per cent relative humidities. So we have to break Grandma's heart by knocking off a couple of her relative humidities. So long as some of her relative humidities remain knocked-off Grandma Dew-point and all her children will remain in suspended animation, so to speak. The moment these relative humidities come to life, however, so will Grandma and all her children come back to life and bring all her troubles with them. So I figured out two ways to bump off some of these relative humidities. One way is to freeze them and the other way is to cremate them. Or if they are real tough, we can freeze them first and then cremate them.

"Build a water tight wooden tank around the high pressure receiver and place this receiver in ice as shown in Fig. 8A. The compressed air leaving this receiver should be below room temperature and the 500 ft of overhead piping will raise the compressed air temperature, resulting in a low relative humidity. Thus all trace of moisture is eliminated.

"If the relative humidities are to be cremated, take a look at Fig. 8B and lower the relative humidities that way. Wrap sheet asbestos around both the stove pipe and around the air pipe, from stove pipe to sprayer connections. This is simple but watch yourself so the fire safety rulings do not give you a black eye."

As far as William T. Mullen of Philadelphia is concerned, Our Hero's compressor has all that is needed to remove moisture from the air. "All I can see is necessary," he writes, "is for Our Hero to open the drain valves on the receivers, intercoolers and aftercoolers. This must be done a certain time every day according to the quantity of moisture that accumulates. On a particular system that I operated the drain valve was left open when starting the plant on full load. This was a large auto body plant operating on three shifts and a large amount of air was used. This drain valve was only partly open, just enough to rid the system of condensate.

"We operators found from experience that when the condensate was carried from the intercooler, from time to time, someone would forget to blow this cooler out for a few seconds and the valve (feather) springs would break.

"The system we used is shown in Fig 9, and is, I believe, something like that used by Our Hero."

Conclusion

On the whole most everybody seems pretty well agreed as to what course Our Hero should follow. The problem was not a very difficult one but it is interesting to see how various people would solve it. Some use arrangement more complex than that of others. I. E. Church of Pittsburgh for example showed three simple types of moisture eliminators in series. C. L. Shobe of Great Bend, Kansas, devised an eliminator built on a centrifugal principle. Chas. W. Parks filled his with hair felt. And so on, each contributed a point of importance. All in all, these solutions give one a good idea of how to remove moisture from compressed air and anybody else running up against the same problem should have no difficulty with it.

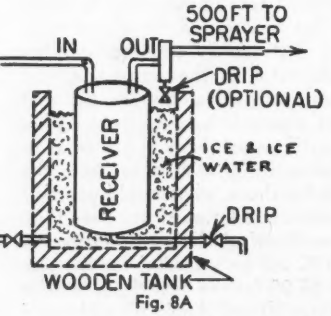


Fig. 8A

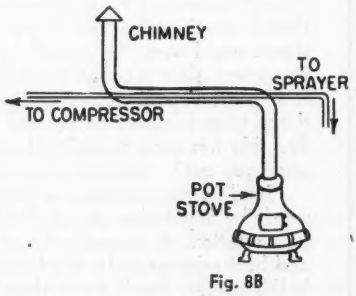
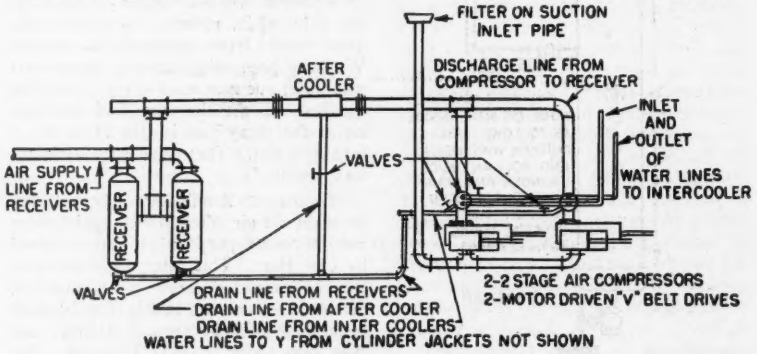


Fig. 8B


FILTER ON SUCTION INLET PIPE
AFTER COOLER
DISCHARGE LINE FROM COMPRESSOR TO RECEIVER
INLET AND OUTLET OF WATER LINES TO INTERCOOLER
VALVES
AIR SUPPLY LINE FROM RECEIVERS
RECEIVER
RECEIVER
VALVES
DRAIN LINE FROM RECEIVERS
DRAIN LINE FROM AFTER COOLER
DRAIN LINE FROM INTER COOLERS
WATER LINES TO Y FROM CYLINDER JACKETS NOT SHOWN
2-2 STAGE AIR COMPRESSORS
2-MOTOR DRIVEN "V" BELT DRIVES
Fig. 9

the Alchemists

. . . had a sweet racket

FROM their dingy, sulphurous dens, the alchemists of old issued false promises of a magic formula that would transmute base metals into gold. It was a sweet racket . . . while it lasted. But it finally gave way to scientific advance.

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LETTERS AND COMMENTS

Operating Pumps by Compressed Air

I WAS VERY interested to find a letter by P. S. Carnes in the August issue of POWER PLANT ENGINEERING, in which he offers considerable criticism in regards my expedient of pumping cores in an ice plant by means of a duplex steam pump which I am operating by compressed air.

I appreciate Mr. Carnes' observations, but wish to disagree in a friendly way with some of his conclusions. In the first place I cannot agree with his estimate that pumping cores with the air driven duplex is costing me 8 to 10 times as much as if I were using an electric motor operated pump. I doubt if it costs twice as much for power and it is actually much cheaper in other ways than the old pump was. If Mr. Carnes or others are still sufficiently interested I'll see sometime just how many gallons of water I can pump with my little 3 by 2 by 3 in. Worthington. (It's in good shape, by the way.) Then I can see how long it will take the 2-stage air cooled Worthington air compressor and 5 hp motor to put the air pressure back to where it was at the start of the test, taking into consideration the difference in temperature, if any, in the air storage tank. I have a meter on the motor to get a line on the power consumption—which is 2c per kwh.

Mr. Carnes suggests a series of articles on the use and misuse of centrifugal pumps. I think that would be fine. My idea of a good example of misuse of the run-of-the-mill centrifugal would be to try to use it for coring ice. The beauty of the little air-driven duplex is that it *always* primes itself. In sucking out the cores we must get clear to the bottom, to get as much of the solid matter as possible. The duplex sucks water, straight air or any mixture of the two. The old pump we discarded was a dandy for failing to pick up the water. The pump motor ran an average of 30 min per day, while the ice puller tried to get the pump primed again. At the time I came to this plant I'll venture to say it was costing—some days—more than one cent per gallon to get those cores pumped! Sure, I'd like an electrically driven suction outfit. It would save us a little money and finally pay for itself. But if Mr. Carnes is right in saying that air power costs from 8 to 10 times as much as electric power, then what a wonderful field there is for electric motor manufacturers to replace all the thousands of air powered hydraulic car hoists in service stations over the country!

Incidentally, the air compressed in this plant costs an average of $13 per month. This air is used in a fairly busy garage for tires, car painting and one hoist. It is also used for stuffing sausages in a small but busy packing house, occasionally for spraying paint on furniture and principally for operating a freight elevator. I have no means of knowing how much air each department uses and cannot shut them all off but one, in order to make some tests.

To give Mr. Carnes a real example of power wasting, I'd like to say that this old freight elevator was originally steam operated. Steam at 80 lb was shot into the top of a conical tank filled with water. This forced the water into the hydraulic cylinder to raise the elevator —weighing at least 1200 lb—and a load averaging a ton. Near the end of the lift the steam was in contact with a water surface 30 in. in diameter. The amount of boiler juice condensed during this operation would most likely be "more than somewhat."

Air, in place of steam, has been used for a good many years now. This outfit is probably 50 yr old and will be replaced after the war. The boiler inspector shudders every time he sees that conical tank.

This is only a small plant, as far as refrigeration is concerned, with a cold storage averaging 12 tons and an additional ice-making capacity of 3½ tons. (It is producing 4-4/10 tons per day now, but not without protest.) The cost of pumping those ice cores is among the least of my worries.

Flagstaff, Ariz. HAROLD S. SYKES

Passing the Buck

AN ARTICLE by George Holman published some time ago recounting the activities of the unconscious saboteur brought to my mind certain types of individuals of quite an opposite kind but whose practices are perhaps even worse, certainly more obnoxious. I refer to those who indulge in what is generally known as "passing the buck".

One of the chief causes of buck passing is a regrettable and unnecessary lack of understanding of the other fellow's problems. This lack of mutual understanding leads to friction and lack of cooperation. In most instances this could be eased by placing in an executive position an individual who understands all phases of the work and who has the knack of getting men to work together in harmony. Unfortunately, such executives are rare.

Several instances of buck passing in the writer's experience are cited as follows:

About two o'clock one frigid morning, the sender on the boiler control system failed, and a hectic half hour was spent until the boilers were brought under control by the operating engineer. Investigation brought out the fact that a cotter key had been left out of a crosspin on a balancing lever the day before the failure. The pin worked out, and the design of the instrument being what it was, the sender called for more steam, yet the safeties were popping. To make matters worse, the sender had been placed in a most inaccessible position, "to prevent tampering". Of course the operating engineer caught hell, as no one would believe that the key had been left out. But it was later known that the mechanic who had last worked on the machine had found a cotter in his pocket. Strangely enough, that cotter was of the exact size of the missing article.

Then there was the case of the overheated type H breaker. Now, no one could reasonably find fault with the design of the type H breaker. It has survived some four decades of development, and still shows the same basic design it started out with, in 1897, I believe.

This particular breaker was rated at something like 1500 amp, and was operated well within rating. However, it heated badly, and switchboard operators had a difficult time phasing with it. Well, the operating crew in that plant took the blame for nearly a year. The remark, "It's not the breaker, it's the operation of the breaker" was in common usage. When they finally got down to cases, and acted like men instead of petulant school boys, it was found that the heating was caused by the pots not being down on the studs in full contact. The bad phasing was caused by the secondary contact rods being out of adjustment, as all rods did not make contact at the same time.

The above mentioned breaker also caused a few red ears. A crew showed up, in full mechanic's regalia to overhaul the breaker. The plant force was brusquely told to keep out of the way and let the men work. The job finished, the breaker would not operate. Blueprints flew like bees around honey. Deep, dark references to "shorts", "continuity", "grounds", "mis-alignment" were carelessly tossed around. Several times the switchboard man, a young punk who should have known better, tried to get the foreman's ear, but was told, "Stand aside, young feller."

When the boss showed up, he instructed the operator to close the breaker, which he did by the simple act of first inserting the synchronizing, or interlocking plug, without which the breaker control circuit was inoperative.

In another case the main drips on a large steam engine were closed, without word being left with the operator. These valves, being in a most inaccessible location, were commonly left open, and the valves on the cylinders were used when starting. Fortunately, the engineman, being a quick witted individual, sensed something wrong the instant she turned over. Of course, no one had closed those valves. No one had been near them, yet their handles were shiny from recent operation!

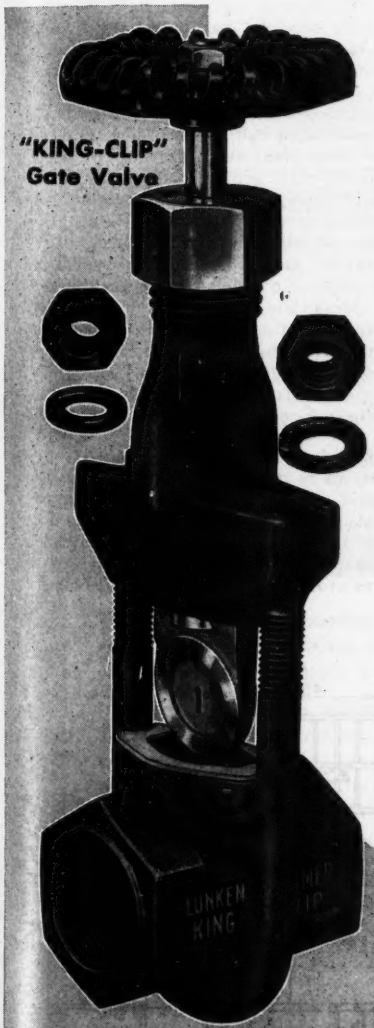
This letter is not intended to be a condemnation, nor even a suggestion. It is a plea, a plea for closer, more cooperative action between all groups concerned with the vital field of the generation and distribution of electricity.

Wingdale, N. Y. SAM WILLIAMS

Simplicity of Design
Means Easier Maintenance

Easy Servicing . . .

A Help for the Maintenance Man



So simple in design, so sturdy in construction, so resultful in last-ability is the "King-clip" valve, only a minimum of maintenance is required to keep it in good working order. And when service is required, the ease with which the valve can be disassembled is a real time and labor saver.

The illustration shows the ready accessibility of all parts for inspection and repairs and how few parts there are. Any maintenance man knows that this provision for quick servicing is a long step toward the uninterrupted production hours he is striving for.

A further aid to the attainment of easier and more efficient maintenance is the precision-gauged manufacture of replacement parts, assuring an exact duplicate of any part that may have to be renewed.

The "King-clip" is built for tough going and with ordinary care it will keep on delivering production hours at the lowest possible maintenance cost.

A Lunkenheimer distributor is near you to help you get what you need. His complete facilities are at your service.

Here's how easily the "King-clip" valve can be disassembled - - - - -

Unscrew two nuts at top of clip and entire bonnet-stem-disc assembly can be lifted from the body. Complete accessibility for inspection or repairs is the work of a few minutes.

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Circular No. 504 is fully descriptive of the "King-clip" Valve. Get a copy from your Lunkenheimer distributor or write us direct.

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Questions And Answers

Question No. 234

How Convert Sleeve-Bearing Motors to Ball-Bearing?

WE'VE GOT a flock of motors around the plant, ranging from 5 to 50 hp, driving pumps, fans and auxiliaries, that we'd like to change over from ordinary sleeve bearings to modern ball bearings. Such a shift would, of course, mean better working efficiency and simplify our wartime maintenance schedules. But we're not quite sure about the proper method of doing this job; where and how the housings should be rebored, etc. We understand that one manufacturer is making this step with changes in end bell. We'd be glad to hear about the experiences of manufacturers and engineers on this subject.

Erie, Pa. R. H. H.

Question No. 236

Why the Difference in pH in These Two Boilers?

WHAT WOULD CAUSE the water in two different boilers to vary in alkalinity and hardness, when both boilers together, or either one alone, delivers steam at the same pressure into the same main steam header, and when each boiler receives its feedwater from the same feed pumps and from the same open heater in the same proportion of return condensate to soft make-up?

There are no other sources of feedwater for each boiler. Periodical analyses show that the chemical qualities of the feedwater throughout the year remain practically unchanged.

One boiler is a 140-hp, four-pass, forced-down-draft Scotch type, normally operated at about 270 Bhp. Boiler water samples are obtained from the water column of this boiler.

The other boiler is a 315-hp, bent-tube, 3-drum, water-tube boiler, normally turning out approximately 350 Bhp. Samples of water are taken from the upper rear drum, which incidentally is the highest drum.

Whether the two boilers operate in parallel, or either of them alone carries all the load for several weeks, during such a period the Scotch type boiler always tends, when uncontrolled, to build up its alkalinity from let's say pH 9.6 to pH 11.0 or perhaps higher, while its hardness would decrease from some 0.4 grains per gallon at the start to neutral within a few days.

On the other hand, the water-tube boiler, when carrying the load partly or alone, would not only maintain a low pH 9.8, but decrease it in a few weeks' time down to pH 9.4, while its hardness would slowly increase from 0.4 grains per gallon to 3 grains and more.

Why do the two boilers not have the same tendencies as to pH and hardness? Both boilers are in excellent condition. Could the design of the boilers or the water circulation have any bearing on the pH? The fact that by close control and individual treatment, of different composition for each boiler, the pH in both boilers is kept at the desired point, pH 11.0, does not explain the unlike tendencies.

Brooklyn, N. Y. H. E.

Question No. 237

How De-Mud Reservoir Without Shutdown?

IN OUR COOLING TOWER installations, one of which is shown in the sketch, water is pumped at the rate of 10,000 gpm from the reservoir, under the towers, to plant condensers and back into the reservoir via the cooling towers. There is a layer of mud on the bottom of the reservoir about 6 in. thick. How can we remove the mud, with the system in operation, without stirring it up so that it will circulate through the system?

The reservoir holds about 165,000 gal of water. It is not desirable to open the P. I. V. drain valve because it might get fouled and cause a plant shut-down. A valve can be installed on the downstream side of the P. I. V. so it would be safe to use this line provided it offers the best solution to the problem. It is desirable to clean this reservoir at three-month periods. Shut-downs to completely drain the system are not possible.

We would like opinions on the best way to do the job.

Perth Amboy, N. J. L. W. L.

Answer No. 212

Why the Large CO_2 Difference?

WHEN H. ETTELT, in the January issue, asked why he got 13.5 to 14.2 per cent CO_2 in the furnace but only 9.0 to 9.5 per cent in the stack gases just ahead of the damper, he said his boiler was in excellent condition, with no leaks in the setting, he was sure.

In his original reply to this question, A. W. Kramer had suggested that the trouble could be due to two things, air leakage or gas stratification, and suggested traversing the gas passages to get an average sample.

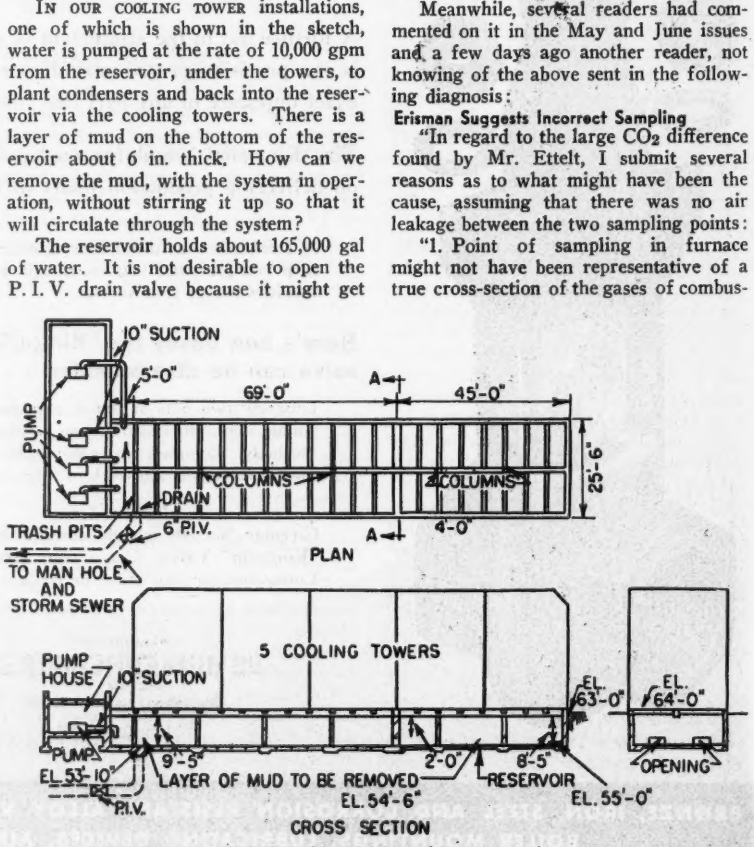
Although the latter had already been considered, it had not been done because the boiler was new and it did not seem possible that, with the boiler's "streamlined" passages all in good condition, this could be necessary. However, the suggestion was followed and, sure enough, there was the cause of the difference. The accompanying sketch tells the whole story.

Meanwhile, several readers had commented on it in the May and June issues and a few days ago another reader, not knowing of the above sent in the following diagnosis:

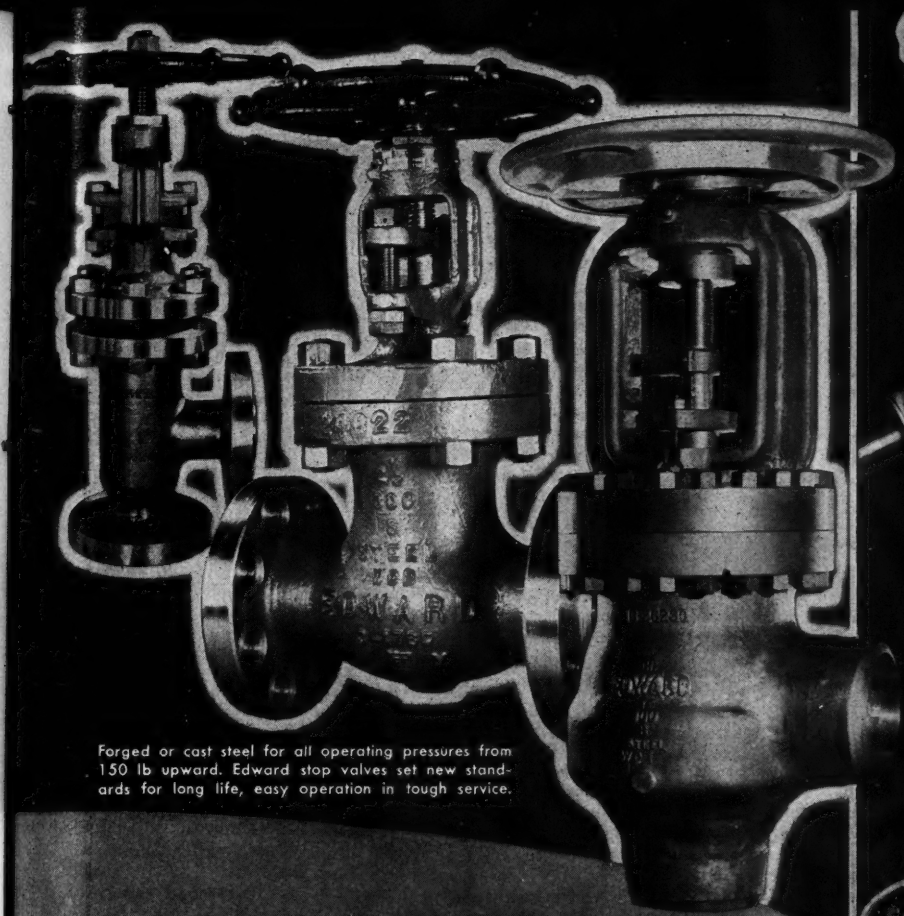
Erisman Suggests Incorrect Sampling

"In regard to the large CO_2 difference found by Mr. Ettelt, I submit several reasons as to what might have been the cause, assuming that there was no air leakage between the two sampling points:

"1. Point of sampling in furnace might not have been representative of a true cross-section of the gases of combus-



Elevations and plan of L. W. L.'s cooling tower and reservoir



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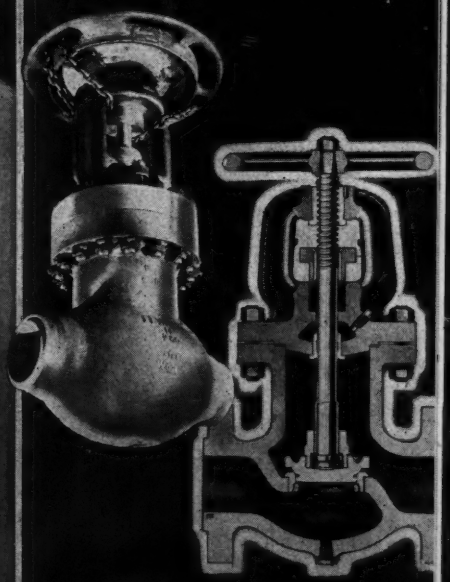

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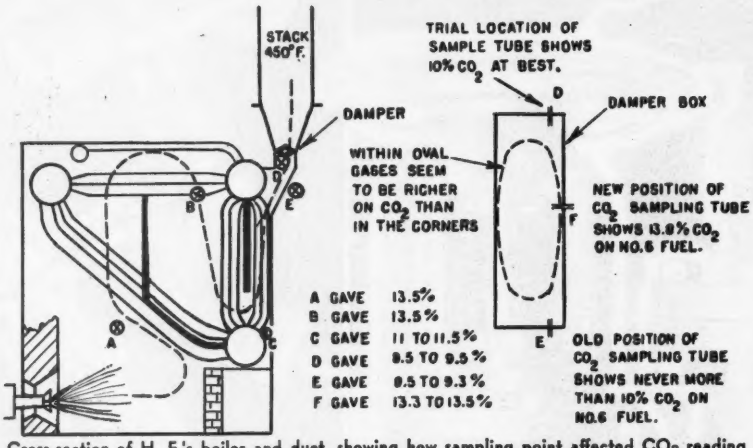
STACK 450°F.
TRIAL LOCATION OF SAMPLE TUBE SHOWS 10% CO_2 AT BEST.
DAMPER
DAMPER BOX
WITHIN OVAL GASES SEEM TO BE RICHER ON CO_2 THAN IN THE CORNERS
NEW POSITION OF CO_2 SAMPLING TUBE SHOWS 13.8% CO_2 ON NO.6 FUEL.
A GAVE 13.5%
B GAVE 13.5%
C GAVE 11 TO 11.5%
D GAVE 9.5 TO 9.5%
E GAVE 9.5 TO 9.3%
F GAVE 13.3 TO 13.5%
OLD POSITION OF CO_2 SAMPLING TUBE SHOWS NEVER MORE THAN 10% CO_2 ON NO.6 FUEL.

Cross-section of H. E.'s boiler and duct, showing how sampling point affected CO_2 reading in stack gases

tion. For instance, if the sampling tube were pushed in a little farther, the CO_2 reading might have been as low or even lower than the stack reading.

"2. End of sampling tube at stack may have been in a gas pocket, since the sampling point was only one foot from the damper. Dampers cause a swirling of the gas stream. If the sampling tube had been placed in the center of the gas stream, the stack CO_2 might have been as high as the furnace reading.

"3. The stack sampling tube might have had air leakage along it where it entered the stack or it might have had a small air leak in the sampling pipe.

"4. Ordinarily the gases of combustion are more thoroughly mixed by the time they reach the stack and, if there are no air leaks into the setting, represent more truly the average combustion. In the furnace, the gas stream is affected by the baffles and tubes and it is possible to have several different CO_2 readings from one side of the furnace to the other, even though the sampling tube is on the same plane."

St. Louis, Mo. JESS L. ERISMAN

Editor's Note—'Nuff sed! To be certain, always traverse the gas passage with the sampling tube.

Answer No. 223

Why Does Total Heat Decrease Above 450 PSI?

IS THERE any simple explanation of the fact that the total heat of saturated steam begins to fall off as the pressure increases beyond 450 psi? To this question, asked by A. W. C. in the April issue, several interesting answers have been received. It is possible to give a simple explanation provided the inquirer knows some of the modern physical theories, but the true explanation gets pretty complicated. The fact itself is easy enough to understand.

We are giving below one of the answers. Other comments came from: Milton N. Kraus, New York; Denard L. Gusler, Morgantown, W. Va.; E. S. Hodge, Port Arthur, Tex., and others. One commentator says, "Many technical graduates have a lot to learn about the use of steam tables." Several readers sent in interesting diagrams and calculations, some of which will be published as space permits.

Incidentally, the term enthalpy as explained below, is now used instead of total heat. It has a different connotation, was agreed upon by leading authorities in steam research and should be adopted by power engineers.

Explanation Is in Kinetic Theory of Matter

THIS IS AN interesting question although difficult to answer without going into theory. This, while interesting to some, is thoroughly detested by others.

Maybe A. W. C. will be satisfied with the explanation that while the heat of the liquid increases with an increase of pressure, the latent heat decreases, and as the total heat is the sum of the two, the maximum total heat is reached between 420 and 470 psi absolute. The accompanying diagram shows the relationship, with values obtained from Keenan & Keyes steam tables. (Thermodynamic Properties of Steam, by Keenan & Keyes; John Wiley & Sons, New York, price $2.75.)

To understand why the heat of the liquid increases and the latent heat decreases with an increase of pressure requires, or is aided by, some knowledge of the kinetic theory of matter.

All matter is assumed to be composed of sub-microscopic particles called molecules that are in continuous but erratic motion and that are held together by mutually attractive forces. The hotter the substance becomes, the more violent will be the movement of the particles or molecules (the sensation of temperature is believed to be due to the impact of molecules on human nerves).

The molecules of a solid are believed to be probably in actual contact and their movement limited, by contact with neighboring particles, to vibratory movement. As the solid is heated, the molecular activity increases, which results in the expansion of the solid, the expansion representing the effort of the molecules to obtain more elbow room. A rise in temperature of course accompanies the addition of heat until a certain temperature, depending upon the nature of the substance, is reached.

When this temperature is reached, further addition of heat causes no temperature rise but the additional heat creates sufficient molecular activity to overcome the inter-molecular attraction and allow the molecules or particles to move over, about and around one another freely. The solid has become a liquid.

If heating of the liquid continues, the liquid expands because of increased molecular activity and separation and this is accompanied by a further rise in temperature, until a point is again reached where the addition of heat causes no rise in temperature. Here the continued addition of heat gives the molecules sufficient energy to overcome the remaining inter-molecular attraction of the liquid and the molecules or particles are free to fly in all directions. The liquid has become a vapor.

While the foregoing is a generalization and is not strictly accurate in all cases, it is sufficient for the needs of this explanation.

It has been concluded that in heating a liquid, some of the heat has been utilized in increasing the molecular energy, which is measurable by temperature rise, and the remainder of the heat added has been used to cause an increase of the volume of the liquid, which is, in effect, work. These two effects have been named or are called "heat equivalent of internal energy of the liquid" symbol u_f, and "heat equivalent of external work of the liquid" symbol Apv_f, respectively, their sum is the heat or enthalpy of the liquid, symbol h_f, which is given in the steam tables, as is u_f. Apv_f is not given but may be obtained by subtracting u_f from h_f.

From the preceding it should be self-evident that the enthalpy of the liquid would increase with increase of pressure.

During the transition of the liquid to a vapor some of the heat supplied is used to speed up the molecules so that their energy will be sufficient to overcome the inter-molecular attraction

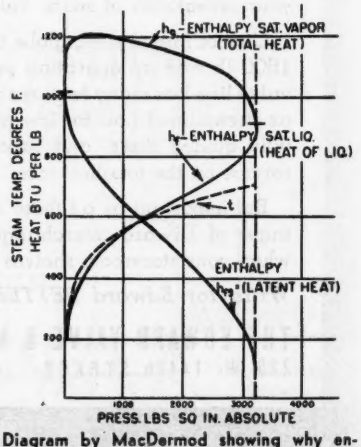

Diagram by MacDermod showing why enthalpy of steam decreases beyond 450 psi absolute

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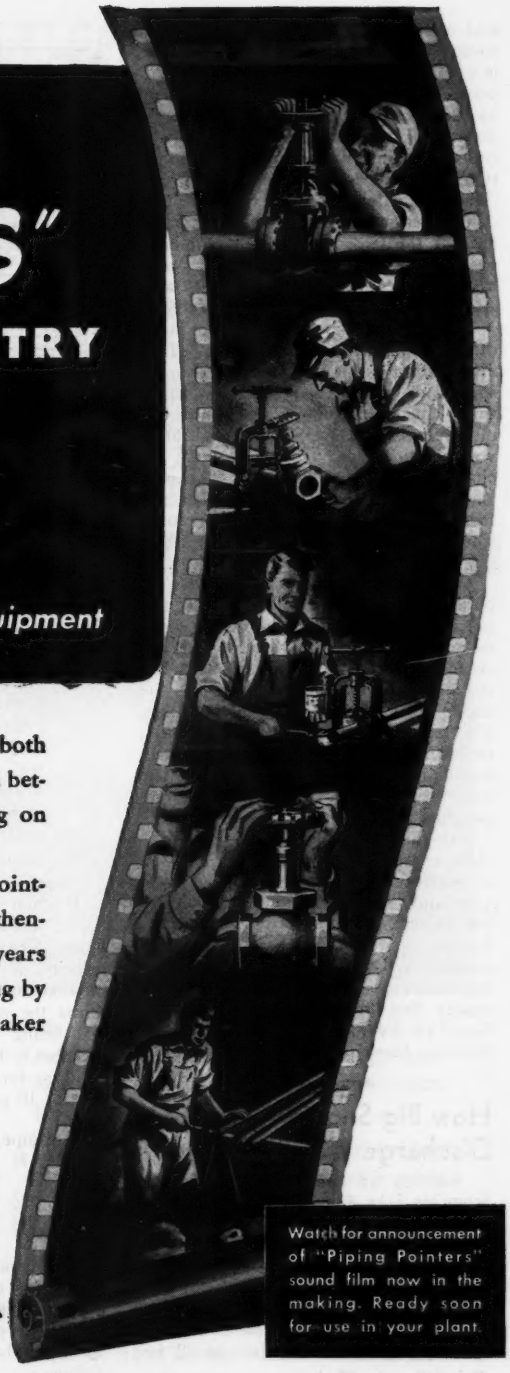

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and allow them complete freedom of motion. The remaining amount of heat is used to change the volume from that occupied by the liquid to that occupied by the vapor, which represents work done. The first of these effects is called the "internal energy of evaporation," symbol u_{fg} and the second the "heat equivalent of the external work of evaporation," symbol Apv_{fg} and the sum of the two equals the latent heat or enthalpy of evaporation h_{fg}. U_g and h_{fg} are given in the steam tables and Apv_{fg} may be obtained by subtraction.

It is logical that decreasing amounts of heat shuld be necessary to effect evaporation of liquids at higher pressures and temperatures. At low pressures the vibration or motion of the molecules is relatively slight and large volume increases are involved in changing from a liquid to a vapor. Large expenditures of energy in the form of heat are necessary to overcome inter-molecular attraction and to effect the volume changes.

With increasing pressures and temperatures, the liquid's molecular motion is more violent resulting in wider separation of the molecules and decreased inter-molecular attraction, and volume changes from the liquid to the vapor state become progressively less. The energy required for overcoming molecular attraction and for performing volume changes becomes less and less until the critical pressure and temperature is reached.

At this point, the liquid has sufficient energy so that no additional heat is required to effect molecular dispersion and, as the volume occupied by the vapor is the same as that occupied by the liquid, no additional heat is required to do external work. The molecules of the liquid have sufficient energy that they can exist either as a liquid or a vapor.

Melrose, Mass. E. MACDERMOD

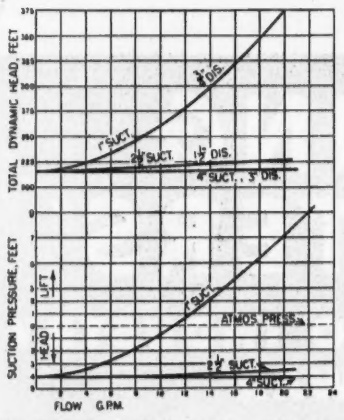
Answer No. 228

How Big Should Pump Discharge Line Be?

SHOULD HE have run a 2½-in. line from his 7 by 4 by 10 in. duplex boiler feed pump to his boiler, asked E.G.S., or was it all right to use a 1½ in. line? The pump has a 4-in. supply and 3-in. discharge; boiler 100 hp tubular type; feedwater at 130 F. Feed is through the blowoff. What difference is there in the friction losses of the two pipes at 90 psi?

Calculations by Clark

THE ASME BOILER CODE specifies that for boilers having more than 100 sq ft of heating surface the minimum feed pipe size allowable is ¾ in., also that for boilers having more than 500 sq ft of heating surface there shall be two independent means of feeding. In Paragraph P-314, the Code states that feedwater shall not be introduced through the blowoff, except that condensate return connections can also have blowoff fittings attached. The Code specifies in detail the method of feed pipe installation at boiler drums.



Graph by C. G. Clark showing rotations between flow, suction pressure and total dynamic head for piping in E. G. S's. problem

Several factors have to be considered in sizing boiler feed piping, such as:

A. The tendency of feedwater and any chemicals added to cause feed pipe deposits thus reducing effective pipe size

B. Friction losses in discharge piping as a function of power required and the cost of such power

C. Friction losses in suction piping. The limiting value is that which will cause cylinder pressures allowing water to flash at the maximum flow rate and water temperature

D. Annual cost including depreciation and power costs.

Friction losses for the exact piping layout should be calculated before installation. Friction losses depend chiefly on velocity of flow and condition of pipe internal surfaces. Static pressure determines the material and grade of paper and fitting required. The head loss in feet due to friction in 100 ft of pipe is as follows, for the sizes shown, at a flow rate of 10 gpm.

Size of pipe, inches	Head loss in feet per 100 ft of pipe
¾	38.0
1	11.7
1½	1.43
2½	0.17
3	0.07

Pump manufacturers will gladly supply tables for calculating friction losses in pipe and fittings.

For purposes of illustration it can be assumed that the piping details are as follows:

Discharge Piping: One gate valve at pump, normally wide open; 40 ft of pipe; five 90-deg ells; one check valve Boiler drum water inlet 10A above pump center line; two globe valves wide open.

Suction Piping. 15 ft of pipe, three 90-deg ells; one gate valve wide open; 4 ft static head over pump center line.

The accompanying graph shows the total dynamic head plotted against capacity for three conditions; namely, 4 in. suction, 3 in. discharge; 2½ in. suction, 1½ in. discharge; and 1 in. suction, ¾ in. discharge. It will be noted that the difference between the first and second pipe sizes is very small, being less than 1 per cent at 9 gpm. For the same flow rate at 9 gpm with 1 in. suction, ¾ in. discharge, the total dynamic head is increased 17 per cent over full size piping.

The pressure conditions at the suction inlet of the pump for the assumed piping layout and various flow rates are shown on the lower part of the graph. For the assumed conditions and water at 130 F, suction conditions would be satisfactory, even with a 1 in. pipe at flow rates up to 10 gpm. Water temperatures may vary and, at times, large increases in capacity may be momentarily required, so it is good practice under normal conditions to pipe the suction the full size of the pump inlet. If actual suction piping is less favorable than assumed, one size larger may be warranted.

If rate of fouling of feed piping is definitely known to be of no significance, the discharge pipe can be reduced safely to 1½ in.

Saint John, N. B. C. G. CLARK

Answer No. 229

Why Does Hot Well Level Vary With Steady Load?

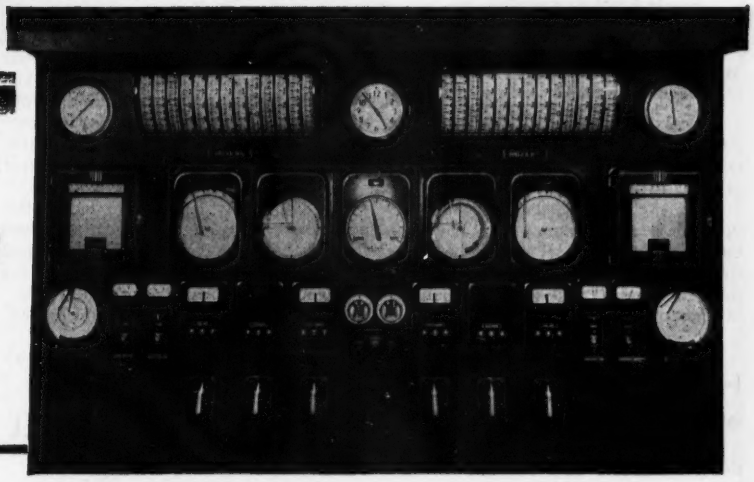
WHEN HIS 550-kva De Laval condensing turbine generator is carrying a constant load, asked W. K. in the June issue, why does the level in the hot well vary from ½ in. to 8 in.? The unit has a 35-lb bleeder connection, takes steam at 200 psi; condensate pump is a constant-speed, motor-driven unit. He gave data on condenser intake and discharge water temperature, condenser vacuum and load. He asked if the pump capacity could increase or decrease.

Pump Capacity Will Vary Under Certain Conditions

REGARDING the question, "Can pump capacity increase or decrease?" the answer is yes; pump capacity will vary under certain conditions.

If pump capacity, speed, head, and net positive suction head are not calculated properly, cavitation will result. This phenomenon can be explained as follows: If an impeller is rotating rapidly through water, a pressure will exist on the driving side of the blade and, at the same time, the pressure is relieved on the reverse side of the blade. If the revolutions are sufficiently high and the slip sufficiently great, a partial vacuum may exist at the back of the impeller to the extent that vaporization of the water will result. Thus reduction in pump capacity occurs until the suction head is built up sufficiently to make water flow in and fill the pump suction. This cavitation effect is detrimental to the impeller because water filling the vapor spaces strikes with considerable force against the back of the blade.

In a centrifugal pump, this effect may be detected by a crackling sound. Water pumped at or near its boiling point, such as condensate from a condenser, must have a sufficient suction head to prevent possible vaporization.



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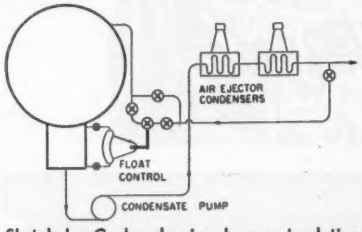
Consequently, W. K. should, by all means, thoroughly check his suction conditions. Make sure the suction pipe is large enough and that he has sufficient head for the pump he is using. If necessary carry the water level higher in the condenser hot well. This type of pump should have a vent line in the suction chest to relieve accumulated vapors. Make sure this line is open and in working order.

If none of the above-mentioned faults exists, then recirculation of a part of the condensate from the hot well will provide a means of holding a constant head in the hot well. Recirculation will also improve air ejector condenser operation and help to properly load the condensate pump.



Sketch by Gusler showing how recirculation of condensate from hot well will help hold hot well level constant

The sketch suggests a possible set-up and is self-explanatory. The pipe entering the condenser should be in the form of a distributor so that the return flow to the hot well will be balanced.
Morgantown, W. Va. DENARD L. GUSLER

Question No. 230

How Stop Bearing Failures on 475-hp Diesel?

IN THE June issue, F. E. recounted the trouble he was having with his Diesel engine bearings. They crack down to the bond, form islands that are then raised up and dragged by the shaft. All bearings are involved. Former trouble with cracking base bolts was corrected by re-alignment of the engine. Suspecting stray electrical currents, bearing pedestals have been grounded.

A very interesting explanation is advanced by Carl Bachmann, while George Holman thinks it may be due to a bent shaft or too early injection.

Too Early Injection on Starting

Regarding the cracking of the bearings and base bolts of F. E.'s Diesel, to me it seems that only two things could cause this: 1, a bent shaft; 2, injection being too far advanced. Doubtless F. E. has checked the shaft. This leaves injection as the only likely remaining source of the trouble.

Does F. E. use a lighter oil with lower ignition temperature to start with? If so, ignition may be much more rapid than when the regular oil is used. It may be so rapid as to build up very high pressures before the piston reaches the end of the stroke. This high pressure would tend to drive a particular crank in reverse to engine rotation, the resulting pound or vibration being unnoticed on starting. The heavy load this would place on the bearing certainly would not be beneficial, even if it neither cracked nor seized.

GEORGE HOLMAN

Bearing Currents—NOT Stray Currents—May Be the Cause

BECAUSE of my experience with a similar bearing trouble, it seems to me beyond doubt that his trouble is emanating–from bearing current (*not* stray current). Grounding the engine and insulating the generator bearing pedestal only aggravated the situation. If engine and generator are direct-connected, what precaution has been taken at the coupling?

I suggest that F. E. first ascertain the presence of bearing current, which at higher density could ruin the shaft. Due to the relatively low voltage and high frequencies it is difficult to obtain direct readings with usual instrument. Therefore, he should use a fine wire from ground to the rotating shaft of the engine and generator. If bearing current is present this will draw a visible spark. The best solution in our case was discharging the bearing current rather than insulating the generator and engine, with its subsequent maintenance.

Temporarily F. E. could accomplish the above by using an old carbon brush holder with the carbon rubbing against the rotating shaft and discharging the bearing current in that manner. Nevertheless, a metallurgist should be consulted.

Schenectady 4, N. Y. CARL BACHMANN

Answer No. 232

How Much Inductive Kick Current Will He Get?

WHAT CURRENT will flow from a generator rotor as "induction kick" current if 250 amp. is flowing just before the normal generator field current is opened and the rotor discharges through a known value of resistance? asked J. W. in the July issue. Also what will happen if the main field resistance burns out? J. W. also gave some interesting data on use of a condenser with a discharge resistor and told how his idea had been to use an arrester in parallel with the discharge resistance.

Formula for Inductive Kick Current

IN ANSWER to J. W.'s question No. 232: First, his diagram Fig. 1 is wrong in that when he opens the field switch his discharge resistance does not short the field. Figure 2 shows it right.

The purpose of a discharge resistor is not to limit the inductive current but to limit the inductive voltage kick. Since a rapidly collapsing field will induce a much higher voltage than is normally applied, it may break down the insulation between the field winding and the pole or between the coils of the winding itself.

If a resistor is shorted across the field on breaking the circuit as shown in Fig. 2, then, when the inductive voltage starts to build up due to the collapsing field flux, a current will flow in the circuit. According to Lenz' law, the flux from the current will oppose the collapsing flux, therefore slowing down the *rate* of decreasing flux and keeping the induced voltage down.

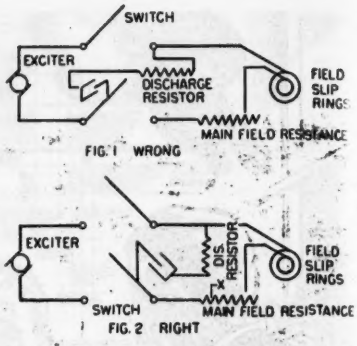


Fig. 1. Wrong—Opening field switch will not put resistor across field

Fig. 2. Right—Opening switch connects resistor as it should be

The usual standard for discharge resistance varies from 1 to 2 times the field resistance.

The induced voltage kick will be $E = N \frac{d\emptyset}{dt}$. Since N is constant, this shows that the induced voltage depends on the rate of change of flux and that the amount of current flowing previous to the interruption does not have anything to do with the inductive voltage or current kick.

The current that will flow through the discharge resistor may be calculated approximately by the formula

$$I = \frac{N \emptyset \div t}{R + Z}$$

Where N = Number of field turns
$\emptyset$ = Field flux at rated field amps
t = time in seconds of field collapse
Z = Impedance of shunt field
R = Discharge resistance + main field resistance

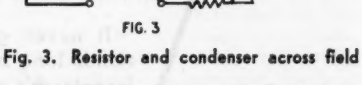


FIG. 3

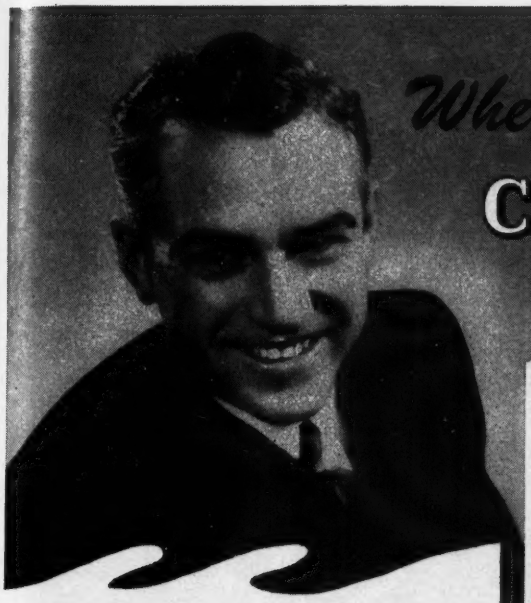
Fig. 3. Resistor and condenser across field

This current is of such short duration that it is seldom used for determining the size of resistor needed.

For the second part of J. W.'s question: No current would flow if the main field burned out at X in Fig. 2 because there would be no complete circuit, although the induced voltage might harm the field resistors.

A condenser might be used in series with the discharge resistor as shown in Fig. 3. The discharge resistor would then draw current only when the field was interrupted with the switch or if the main field would burn out.

Pittsfield, Mass. JERRY HALSTEAD



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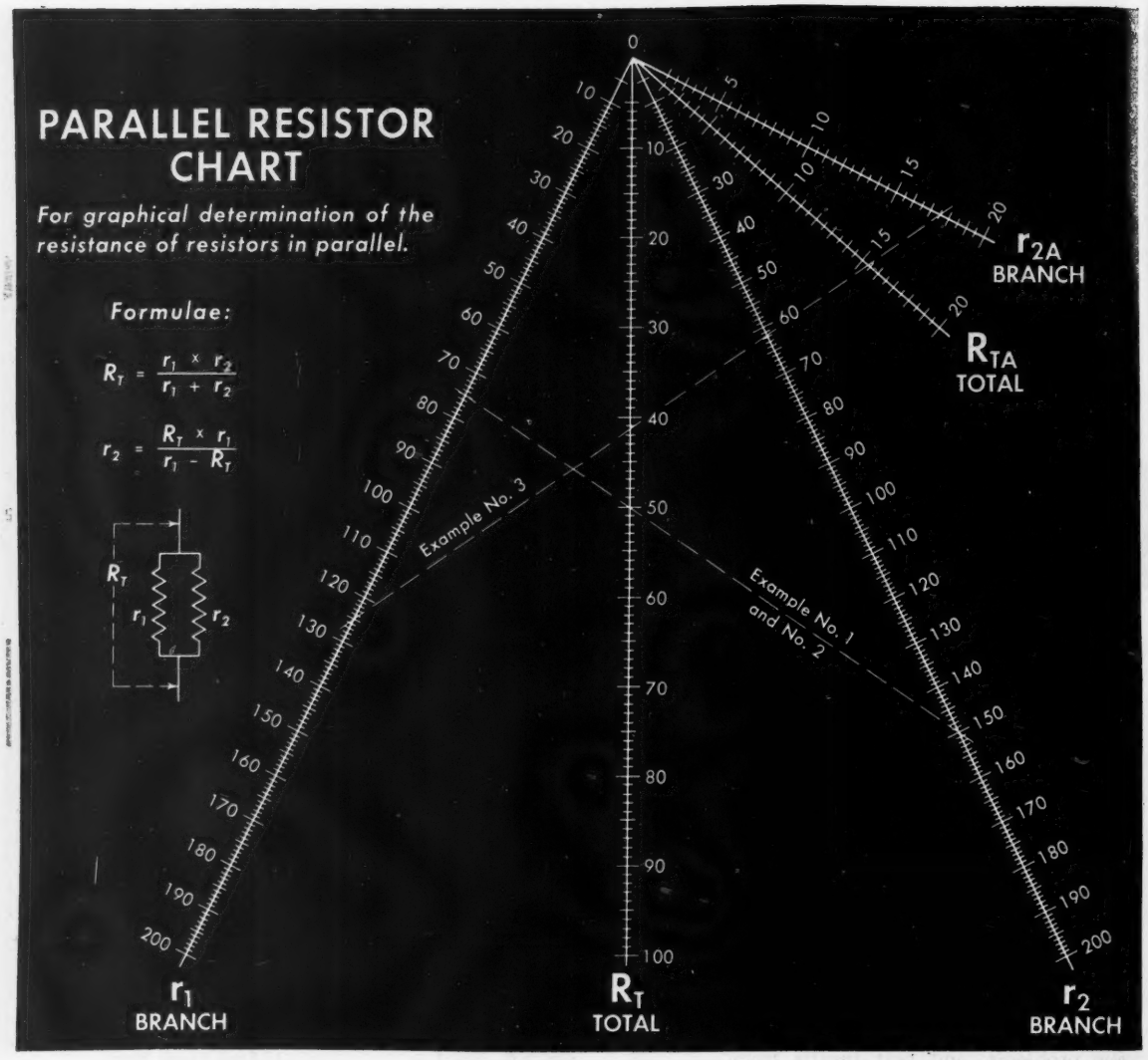

Courtesy Ohmite Mfg. Co.

PARALLEL RESISTOR CHART

Here is a handy chart devised by the engineers of The Ohmite Co. of Chicago for the graphical determination of resistors in parallel. The values of the parallel resistors r_1 and R_2 and of the total effective resistance R_T must be read on the scales marked with the corresponding letters. To use the chart, place a ruler or other straightedge across the two known values of resistance; the point at which the ruler crosses the third scale will show the unknown resistance value. Pairs of resistances which will produce a given parallel resistance can be determined by rotating a ruler around the desired value on the scale R_T. The range of the chart can be increased by multiplying the values on ALL the scales by 10, 100, 1000, etc., as required. Scales r_{2A} and R_{TA} are used with scale r_1 when the values of r_1 and r_2 differ greatly.

To show exactly how the chart is used the following examples are given:

Example 1. What is the total resistance of a 75 ohm resistor and a 150 ohm resistor connected in parallel? Answer: From dotted line No. 1, R_T is 50 ohms.

Example 2. What resistance in parallel with 750 ohms will give a combined value of 500 ohms? Answer: From dotted line No. 1 r_2 is 1500 ohms.

Example 3. What is the combined resistance of 1750 ohms and 12,500 ohms? Answer: Scales r_1 and r_{2A} are used and from dotted line No. 3, R_{TA} is 1535 ohms.

Example 4. What is the combined resistance of 400, 600 and 800 ohm resistors in parallel? Answer: First find R_T for 400 ohms and 600 ohms. Then set the 240 ohms thus found as a new r_1 and 800 ohms as r_2 and the final answer is found to be 185 ohms.

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War puts a severe strain on diesel engines, too. Heavier loads . . . longer runs . . . make proper lubrication more important now than ever.

One manufacturer, operating on a full wartime schedule, was having trouble on his Fairbanks-Morse diesel. Excessive carbon collected and clogged the ports . . . the top rings stuck within 2 or 3 months after cleaning . . . oil had to be changed every 3 months.

A Sun Industrial Engineer, called in to help remedy the condition, suggested they change from a competitive lubricant to Solnus Heavy Oil. The change was made . . . the condition cured. One year later they had experienced not a single stuck ring with Solnus Oil . . . carbon on the ports had been greatly reduced . . . and time between oil changes was extended 33⅓%.

Service like this is being rendered today in plant after plant by Sun's Doctors of Industry and Solnus Oils. If you want smoother diesel performance in your plant, investigate these lubricants that are low in carbon content, neutral in acidity, wholly distilled, durable. Consult a Sun Engineer about them now. Write

SUN OIL COMPANY · *Philadelphia*

Sun Oil Company, Limited, Toronto, Canada

SUNOCO

SUN INDUSTRIAL PRODUCTS *HELPING INDUSTRY HELP AMERIC*

(*Continued from Page 71*)

protect themselves against seniority rules of promotion is to get employees that can go up. In the extreme interpretation of seniority promotion, management should not hire anyone who was not capable of being "the management." That is a little "stretched"—but too many times organized labor has forced the promotion beyond the man.

After an applicant has been judged qualified by age, education, experience, marital status, etc., a few "don'ts" should be applied before his employment:

1. Don't hire men and women for the same jobs in operation or maintenance. Men and women have worked together in the office for years, but, in spite of the war, we are not ready for a wholesale movement yet.
2. Don't hire racial trouble. As a national group, we are becoming more tolerant. We are getting used to all classes, creeds, and races in public groups where one goes or not as he pleases. **But when the problem confronts an individual in his home, his work, or his family, he usually shows a great degree of intolerance.** Take this as you will, it is still a fact.
3. Don't promise too much in trying to sell the job. Employers have had very little experience in "selling" their jobs in this country. Up to the past few years, there have been more men than jobs. When the tide turned, management in their panic sometimes has promised the moon to get the man.

Training

Each employee should be made to know what is being produced, what the product is good for and what the efficiency of production is. It is only by letting them know the importance of their work that employers can hope to secure their participation and cooperation in plant betterment. Let them know what the efficiency or output of production really is and what it might be if there were perfect co-ordination.

Each employee should have a general idea of the duties and responsibilities of others. It makes for better understanding and respect of the other fellow's job.

No legitimate question should go ignored, even if at the time there is no ready answer. It is a fallacy that one's job is more secure if he keeps his knowledge of the job to himself. That goes from the boss on down. The more each man knows how and what to do, the less his boss will have to do. Really there should be no glory for a supervisor who has to be called away from a party, a show, or his date with Morpheus, to go down to the plant to fix a gadget that the man on shift could fix if he only had been told or shown how.

Last and maybe most important, all employees should know the line of organization or authority in the staff. It is embarrassing to both superior and employee when mistaken identity might be construed as disloyalty or disrespect. Not only that, but a clear understanding as to who may issue orders will save a lot of buck passing.

If, in the company, seniority or labor regulations dictate the up-grading of personnel, it is up to management to force all the training on all the employees that they can possibly stand.

Suggestions to Make for Better Operators

1. **Do not crowd the operator's time with recordings. Make him an observer, not a recorder.**
2. **Forbid the reading of any but trade journals on the easy shifts, all reading on the regular shifts.**
3. **If tests are run, let the operators know the results. Keeping the results a secret may give the impression that the test was really a check on the operator.**
4. **Reduce report calculations to simple arithmetic. If it is necessary for the operator to have to make reports in pounds of steam, gallons of water, or barrels of oil, have meters that have easy constants. It will save time and reduce the number of errors on the reports.**
5. **Where possible, supply tables, charts, or performance curves of expected operation. This gives an operator a rapid check at all time to see if he is "on the beam."**
   a. **For instance, a curve showing expected feed water bleed heater temperatures against load gives a quick check for air binding, or trap flooding.**
   b. **Pump curves showing head, flow and expected amperes give quick indication of fouling runner, loss of suction, tight packing, etc.**

Is all this worth while to management? The answer is always found in the Personnel Office. It just depends on how much it costs to hire a man. The cost for interviews, physical examinations, record search, and identification verification can well run over $100 per employee. Add to that, the cost of paying moving expense and his first few months' salary and the figure can run up to $2000 in some cases. After this investment, it surely behooves the company to do everything it can to keep, promote, educate, and up-grade its employees.

If the program is successful, the "damn company" will change to "my company."

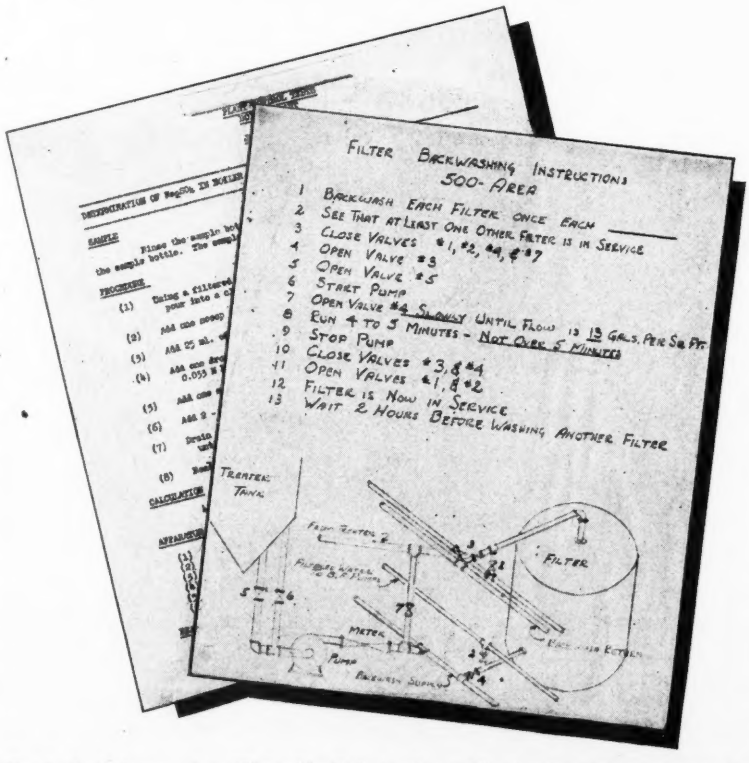
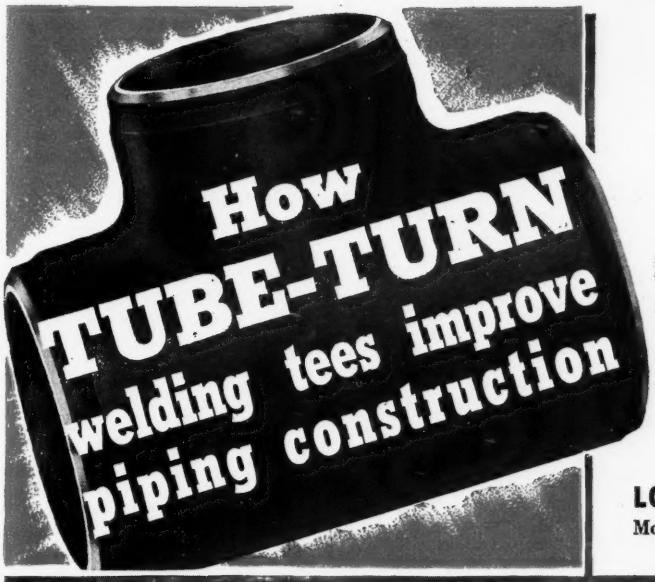
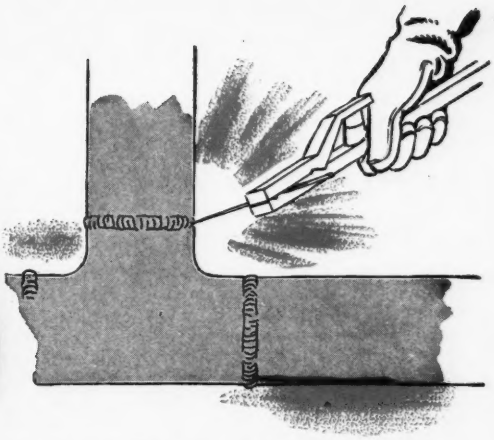

FILTER BACKWASHING INSTRUCTIONS
500- AREA
1 BACKWASH EACH FILTER ONCE EACH
2 SEE THAT AT LEAST ONE OTHER FILTER IS IN SERVICE
3 CLOSE VALVES #1, #2, #4, & #7
4 OPEN VALVE #3
5 OPEN VALVE #5
6 START PUMP
7 OPEN VALVE #2 SLOWLY UNTIL FLOW IS 13 GALS. PER SQ. FT.
8 RUN 4 TO 5 MINUTES - NOT OVER 5 MINUTES
9 STOP PUMP
10 CLOSE VALVES #3, & #4
11 OPEN VALVES #1, & #2
12 FILTER IS NOW IN SERVICE
13 WAIT 2 HOURS BEFORE WASHING ANOTHER FILTER
TRAINER TRAIN
FILTER
METER
PUMP

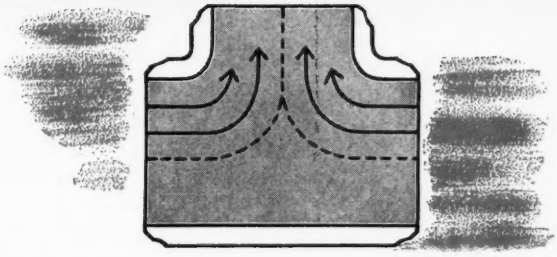
Fig. 7. Typical pages from Bill Maddock's instruction publications issued to every operator in a new industrial power plant. The operating staff included both men and women; they had never worked together before nor on this type of work. The equipment was described by a number of mimeographed booklets, illustrated with simple but accurate diagrams, in most elementary terms but in some detail, so that all would have the same ideas about its purposes and principles. In conjunction with the descriptive data, a 5-day course was given on the general industrial plant flow sheet and a 6-day course on the operations of the power plant equipment, supplemented by individual instruction for specific operations





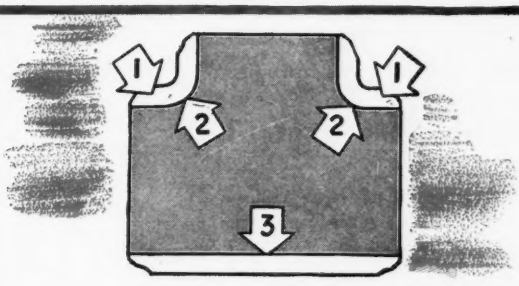
LONGER OUTLETS SPEED WELDING

More room for easier manipulation of rod means faster welding and better, sounder welds.



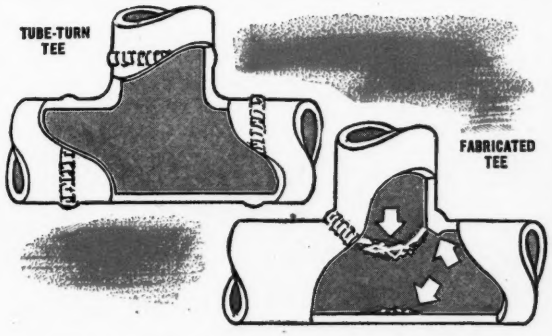
SMOOTH FLOW, LESS PRESSURE LOSS

Smooth inner walls assure even flow and reduce wear. Rounded inside crotch reduces pressure loss.



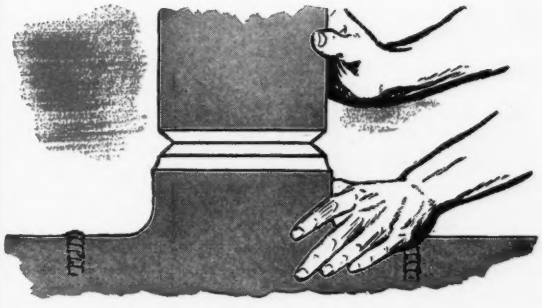
EXTRA STRENGTH AT STRAIN POINTS

Added thickness at top of run (1), crotch (2) and bottom (3) strengthens points of highest stress.



NO FABRICATION FAULTS

Fabricated tees often have jagged corners, crude welds, and slag. Tube-Turn Tees eliminate these.



FASTER, EASIER ALIGNING

Accurate bevels, plus I.D. and O.D. that exactly match the pipe, make aligning simple and speedy.

TUBE-TURN
TRADE MARK
TUBE TURNS (Inc.) Louisville, Ky. Branch offices: New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Houston, Los Angeles. Distributors in principal cities.
Welding Fittings and Flanges
NO. 8 OF A SERIES
HOW TUBE-TURN WELDING FITTINGS BENEFIT WAR INDUSTRY
The FIRST WELDING FITTINGS
1ST

(*Continued from Page* 75)
have a full understanding of fundamentals that they can be safely entrusted with the tremendous forces and latent energies existing in any high-pressure steam plant.

CLARENCE H. HOPER,
City Manager

WISCONSIN ELECTRIC POWER COMPANY
MILWAUKEE, WISC.

THE TRAINING METHOD which we are employing for up-grading power plant men is an elaboration of the plan that has been used for a number of years. It consists of stepping men up into the higher positions for training whenever vacancies occur in those positions or when there is part time work in them. In this way, the men obtain actual experience for the job ahead of them, and we find that it works very well. Our principal difficulty now is to obtain men to start at the bottom for training.

In addition to this we have endeavored to give the men special instruction in subjects related to their work, such as boiler-room practice, feedwater treatment, etc., but we are finding it almost impossible to carry on this work due to inability to obtain instructors. However, last spring a course in boiler room practice, which was attended by 75 men, was completed.

Thus far we have not used women but facilities are planned or being installed in three of our plants so that women can be accommodated. In our largest plant we will probably start employing women within a week or so. Depending upon the physical characteristics of those employed, we expect to start them in operation of ash handling equipment and in helper positions of various kinds in the turbine and boiler rooms. In the various machine shops, they may also be employed as helpers.

F. L. DORNBROOK,
Chief Engineer of Power Plants

AMERICAN GAS & ELECTRIC SERVICE CORP.
NEW YORK

THE COMPANIES of the American Gas & Electric Company systems, like most companies, found that due to the manpower situation special consideration had to be given to the training of personnel for all departments and particularly to that for power plant operation.

Shortages caused by releases to the armed forces were only partly filled by the upgrading of remaining personnel that was already partially trained. Some of the more difficult jobs in power stations were filled by transferring men from other departments, but the final gaps were in many cases filled with women.

Many problems were, of course, encountered in the training of women for jobs previously handled by men, but, in general, these are being overcome to the mutual satisfaction of the employes and management.

Averages are not the final answer in personnel problems, but some idea will be given by the records. These show a net loss for all the systems of 14 per cent of personnel since the war started, with an increase of women of approximately 10 per cent of the total payroll, or practically double the number of women in proportion to men.

The danger involved in interpretation of such figures is their failure to show the very high percentage of loss of technical and skilled personnel that cannot be replaced with any training program in the time available. The load, however, is still being carried and will continue to be carried by spreading the technical and skilled men as thin as necessary and supplementing this, as far as possible, by a speed-up of the training program.

FORD MOTOR COMPANY
DEARBORN, MICH.

IT HAS OFTEN been said that an airplane, a ship, etc., regardless of cost, is no better than the men operating it. The same holds true in power plant engineering.

While we have lost our share of men to the Armed Forces, which did handicap us in respect to already experienced men, we have been fortunate in holding on to a majority of our operators, both steam and electrical, because most of them are out of the draft age.

When the Ford Motor Company converted the huge Rouge Plant over to 100 per cent war work, many new buildings were erected, which required the services of a large number of power equipment operators and maintenance men for electrical, heating and refrigeration work. Because of the shortage of manpower, no experienced men being available, it was necessary to train them for their respective jobs. These, together with other replacements, are trained:

1—By placing them with experienced men until they themselves are capable of assuming full responsibility of the operation or maintenance of the job.

2—By maintaining a school wherein the men may receive the theory or operating principle of the job, whether it be steam, electrical or refrigeration.

While the number of women employees in the plant are counted by the thousands, doing work which was formerly held exclusively by the so-called masculine sex, and while they are giving a good account of themselves, no women, as yet, are employed as power equipment operators. But that time may not be far away, and, when and if that day does arrive, we will feel with confidence that the station will still be in capable hands.

W. W. DULMAGE,
Power Dept.

BUFFALO, NIAGARA AND EASTERN POWER CORPORATION
Buffalo, N. Y.

THE TRAINING methods we have used in up-grading power plant operators and men for power plant and maintenance work at Huntley, our Buffalo steam-electric station, consist of putting the man who is to be up-graded along with an old employee for several weeks. He learns simply by working with his fellow employee, who is experienced in the particular job. Also he receives verbal instructions on the job from the shift foreman or supervisor.

For the last half year or so we have employed very few new and inexperienced men, simply because very few men were available.

During the last half year or so, we have employed about 85 women to fill the following kinds of jobs: turbine or boiler auxiliary operators, oilers, technicians, clerks, telephone switchboard operators and janitors. There are about 600 employees at our Huntley station.

The women have proved satisfactory, in general, although their absenteeism is a little greater than that of the men. However, they have learned as quickly as would a new man and have been more conscientious about their work than men have been. During the first week of their employment, the turnover has averaged between 5 and 10 per cent. However, if they last through the first week, they seem to stay on indefinitely. We have had some minor annoyance in the employment of women in that they do not conceal their jealousy of each other's advancement.

We have not printed outlines of courses or issued instruction manuals. Our instruction has been entirely verbal. The new women spend several hours each day of the first three weeks receiving classroom instruction, the remainder of the day they spend observing and working along with old employees. Illustrations of the work these women are doing are given in the pictures on page 72.

EDMUND R. PAIGE,
Superintendent of Technical Training

NORTHWESTERN ELECTRIC COMPANY
PORTLAND, ORE.

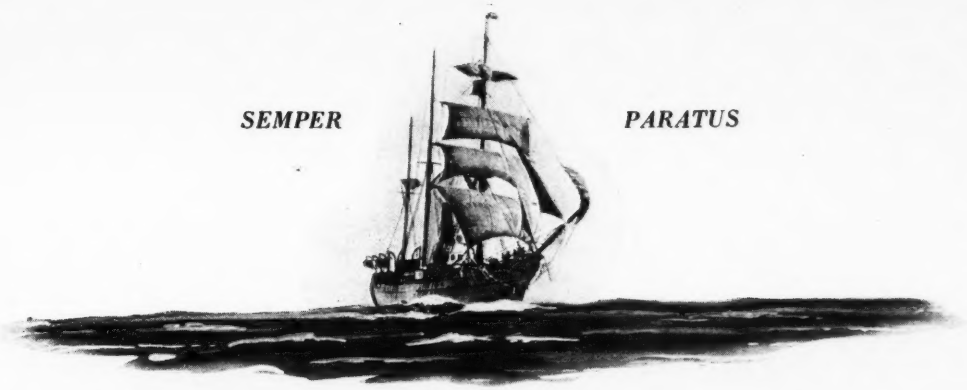
AT THE BEGINNING of the War, we lost some men from the power plants who went to the shipyards where a higher rate of wages was paid. As the average age of our power plant employees is rather high, the number of men lost to the Armed Forces was not great.

Prior to the beginning of the War, we worked on a 5-day week basis. We have since gone on a 6-day week basis, which took up the slack until about three months ago when labor shortage commenced to cause difficulties. But so far we have not used any special training methods for up-grading power plant operators and training new and inexperienced men other than used previously.

Our office force works on a 5½-day basis and we have used some volunteers from the general superintendent's office who worked in the power plants either Saturday afternoon or Sunday at such work as cleaning condensers.

O. L. LEFEVER,
General Superintendent

(*Continued on Page* 126)

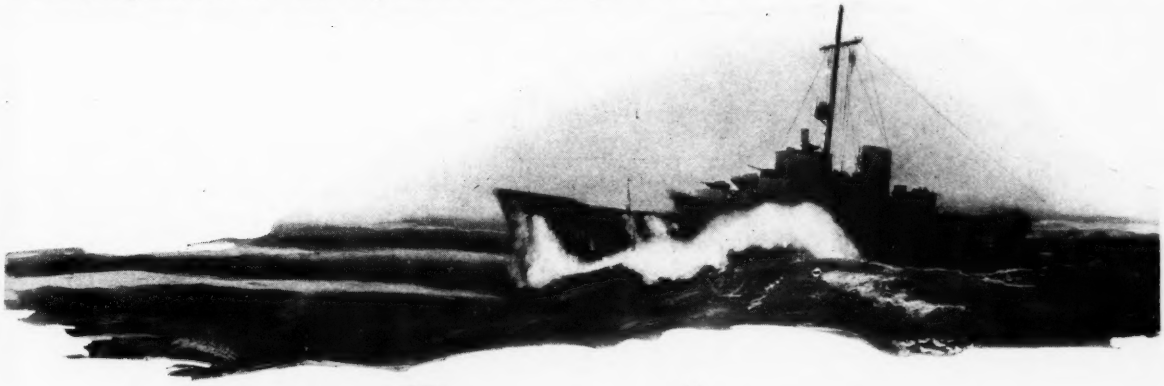


FROM THE OLD COAST GUARD "BEAR" TO THE NEWEST 327′ CUTTER

Worthy as she is, the old Coast Guard Cutter BEAR—back on duty—cannot compare with the new, sleek 327 foot PG's with their 6,200 horse power doing better than 20 knots.

THERE HAS BEEN PROGRESS IN WATER CONDITIONING, TOO . . . Passing out are the former "standard practices" for water conditioning. Today, through skilled diagnosis and preventive measures, the enemies of steam production and of other industrial uses of water—scale, corrosion, carry-over and embrittlement—are stopped *before* they can apply their destructive power.

The Bird-Archer Organization of Mechanical Engineers, Chemical Engineers and Chemists is fully staffed and entirely competent to analyze water conditioning requirements in your plant and to set up the proper conditioning method. No other organization is better qualified for this work.



THE BIRD-ARCHER CO.

Water Conditioning Service

SURVEYS • PLANT STUDIES • CONSULTATIONS
PLANT DESIGN • SUPERVISORY SERVICE
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NEW YORK	*N. Y.*
CHICAGO	*ILL.*
PHILADELPHIA	*PA.*
MONTREAL	*CAN.*

Official U. S. Coast Guard Photos

The Topping Program at Sherman Creek

(*Continued from Page* 81)

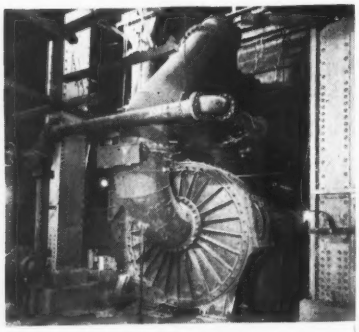


Fig. 9. The No. 2 coal mill

control of this and future boilers, the entire control is located on the 72 ft-1 in. elevation. On this elevation is assembled the control benchboard and panel, feed pump control and the sight gage system from gage glasses to control board.

The combustion control was furnished by Republic Flow Meters Co. and is arranged to regulate air flow, furnace draft and coal feed to maintain steam pressure.

Bailey Meter Co. three-element control (water flow, steam flow and water level) is provided to vary speed of turbine driven feed pumps as required by feedwater demands.

The boiler control boards consist of a benchboard and vertical panel. On the benchboard are mounted the controls for mills, feeders, fans, ignition torches and feedwater, together with position indicators for these controls. This board also contains indication and control of the burner and bypass damper positions.

The boiler feedwater is essentially condensable. As make-up is required, it is normally fed into the low pressure boilers. However, if this is insufficient, the make-up is then fed to the high pressure unit. To pre-treat the make-up, a 50,000 lb per hr Permutit Co. softening plant is provided, consisting of a hydrogen Zeo Karb exchange unit (regenerated by sulphuric acid) and a sodium Zeo Karb unit (regenerated by salt brine). The make-up water is passed through both units in parallel. The hardness free effluents of both units are then mixed and cascaded through a degasifier which removes most of the carbon dioxide from the water.

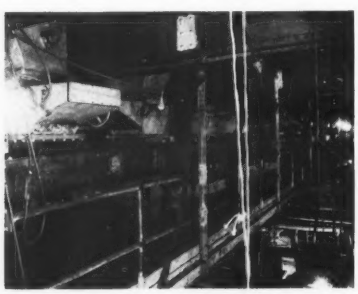


Fig. 10. The Redler Conveyor.

In addition to pre-softening the water, provision is made to chemically treat all feedwater to the high pressure boiler as required to maintain the proper boiler water conditions. For this purpose, the Proportioneers, Inc., motor driven duplex variable displacement chemical feed pumps have been provided to feed caustic into the feedwater system ahead of the economizer and to feed tri or disodium phosphate directly into the boiler drum.

The continuous blowdown system for this boiler and future high pressure units consists of a high pressure flash tank which flashes 33 per cent of blowdown in the station 200 lb per sq in. steam system and a low pressure flash tank which receives the drains from the high pressure tank and flashes 17 per cent of such drains into the station auxiliary exhaust system. The system has a capacity of 150,000 lb per hr of blowdown which can be fed to the flash tanks through a system of orifices designed for various blowdown rates. The flash tanks were made by B. & W. Co.

In the design of this unit, it is felt that a trouble free installation easy and convenient to operate with a high availability has been accomplished.

The Role of Capacitors in War Work

(*Continued from Page* 84)

Week-end—Negligible

Transformer bank 2000 kva with 3.6% magnetizing kva

$3.6 \times 2000 = 72$ R-kva for magnetizing

kwh $= 960 \times 154$ hr per month $= 147{,}840$

R-kvah $= 1065 \times 154$ 164,000

In order to raise the power factor to 95 per cent,

$$\frac{147{,}840}{95\%} = 154{,}500 \text{ kva}$$

$\sqrt{154{,}502^2 - 147{,}840^2} = 43{,}500$ R-kvah at 95% power factor.

The capacitor must supply 164,000 — 43,500 = 120,500 R-kvah. The transformer bank represents 730 hr per month $\times$ 72 = 52,500 transformer R-kvah. A 72 kva capacitor will be 100 per cent effective for 730 hr in the month, and will offset 52,500 lagging R-kvah.

The balance needed = 120,500 — 52,500 = 68,000 which must be accumulated during the day, or during 154 hours of the month.

$$\frac{68{,}000}{154} = 442 \text{ kva}$$

The total size of capacitor = 72 + 442 = 514 kva. In this case it will probably be desirable to disconnect the 442 kva portion of the capacitor during light load periods. However, this is largely a matter of voltage rise and such rise is determined by the circuit reactance as pointed out in the first part of this discussion.

Problem No. 4—Correction of Instantaneous Power Factor

Resistance welders produce high momentary kva demands and although these demands may be recorded on a meter, the voltage fluctuations may cause excessive lamp flicker. This particular condition may be improved by means of capacitors in either of two ways.

(a) Install capacitor kva to offset line reactance.

(b) Install capacitor kva to offset individual load reactance.

For condition (a), since the voltage dip is the result of line drop, any reduction of that drop will also reduce the lamp flicker. Thus a capacitor, whose reactance (X_c) is equal to the line reactance (X_L), may be placed in series with the supply line; the voltage dips will be reduced as a result. However, consideration must be given to other features of this arrangement such as the following:

(1) The series capacitor must be designed for total line current.

(2) It must be protected against over-voltage developed during line fault, which adds to the cost of the installation.

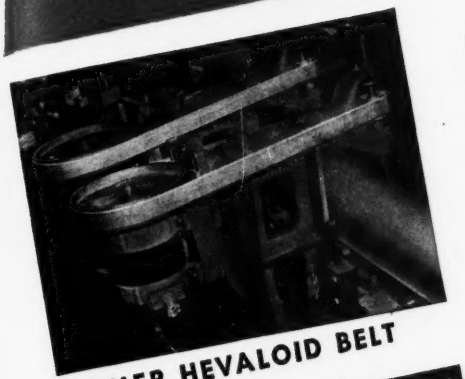
(3) It must be insulated for line-to-ground voltage, the line must either be de-energized or a set of nine disconnects must be provided for isolating the capacitor for maintenance work.

(4) The series capacitor is costly per kva if the line voltage is less than 4600 v since low voltage units are more expensive.

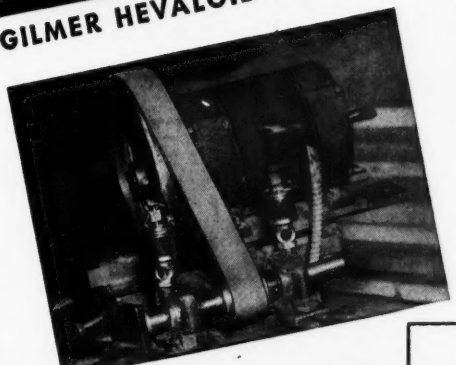
For condition (b), where a series capacitor is installed to cancel the reactance of an individual load, the loads responsible for the disturbance are usually relatively small. Such series capacitors are used on resistance welders and must be designed so the supply

(*Continued on Page* 124)

A SPECIALIST DOES THE JOB RIGHT!



GILMER HEVALOID BELT



GILMER SPEEDAGE BELT

GILMER *specializes* in belts! As the oldest firm of rubber-fabric belt specialists, with over a third of a century of experience in building belts for machinery all over the world . . . Gilmer has developed a complete line of standard V-Belts and Endless and Non-endless Flat Belts. The largest assortment of V-moulds in the world is maintained . . . necessary for the production of a well rounded line. In addition, engineering and manufacturing facilities are maintained for highly specialized belts for use wherever standard belts are unsuited.

V-Belts for multiple and light duty drives.

Kable Kord Flat Endless Cord Belts, a contactor and power belt, two-belts-in-one.

Gilmer Hevaloid Endless Belts: Light weight and vibrationless for high speed precision work.

Flat Roll Belting for line shaft drives.

High Speed Belts **Special Endless Belts**

Round Endless Belts **Planer Belts**

and Belts for Textile and other specialized industries.

- Write for a FREE copy of Gilmer's Handy Belt Selector . . . a mine of information.

USE WHAT YOU LOSE

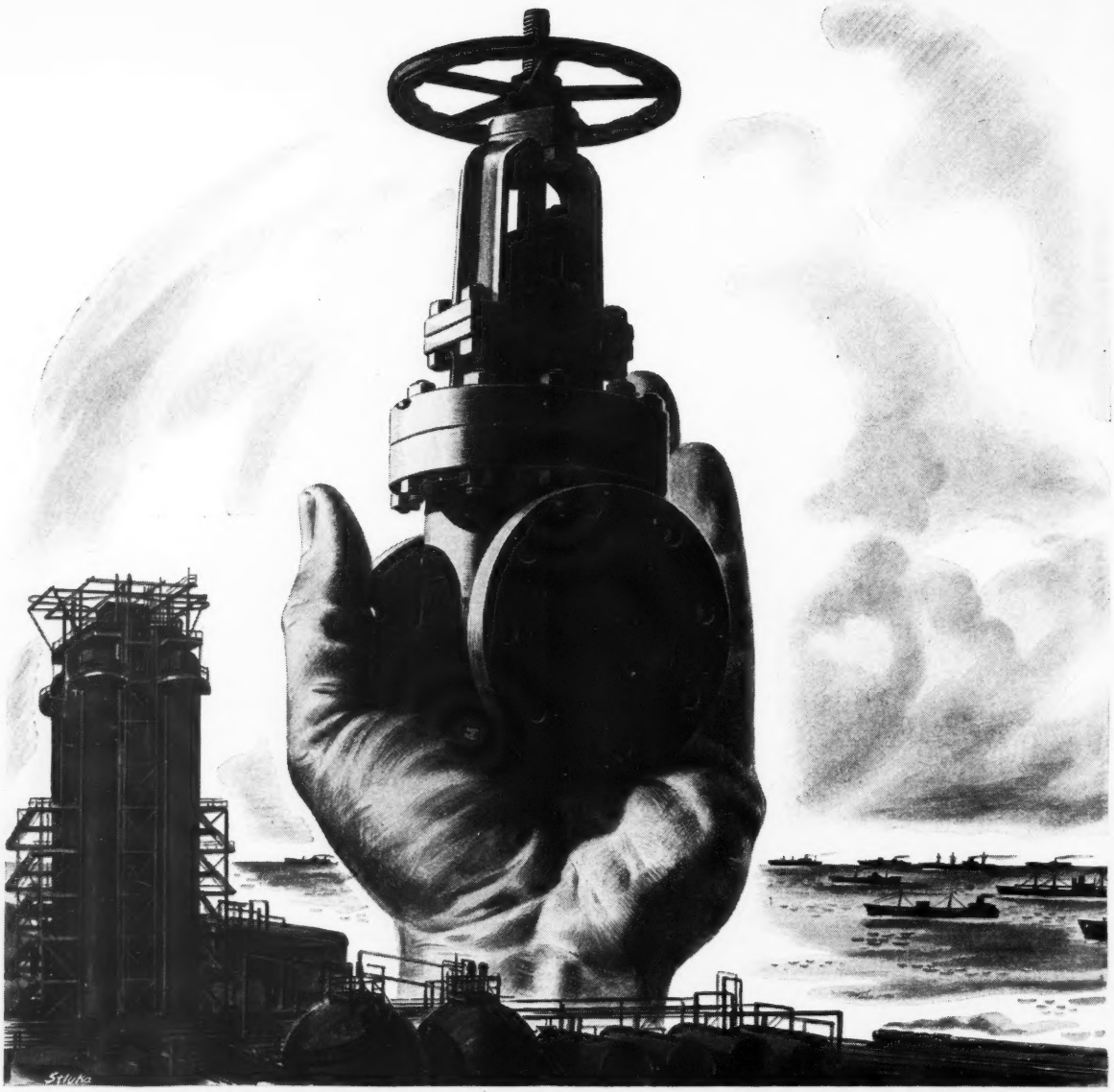
Gilmer BELTS

MORE POWER TO YOU

The Gilmer Engineering Staff specializes in power transmission problems. And the same ingenuity which is solving belt problems all over the country, also has planned an important FREE wartime service to Industry. It's the Gilmer National Power-Recovery Plan, approved by the WPB to save power in the following services: Steam, Gas, Water, Electricity, Mechanical Transmission, Boilers, Compressed Air, Refrigeration and Prime Movers. Write for your FREE copy today.

L. H. GILMER COMPANY, Tacony, Philadelphia 35, Pa.

The Oldest Firm of Rubber Fabric Belt Specialists



CONTINUE TO "GUARD THOSE VALVES"

Since such tremendous tonnage must be carried to forces around the globe, it is easy to understand why Reading-Pratt & Cady for so long have advised you to "guard those valves." Ships are a maze of valves. ★ Strides toward victory should not encourage the thought that the transport of matériel for fighting Americans be put in jeopardy—so that we at home might have more. Now is the time to put into war every ounce of drive we can muster. Continue to guard your valves.

READING-PRATT & CADY

MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

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A DIVISION OF AMERICAN CHAIN & CABLE COMPANY, Inc., BRIDGEPORT, CONNECTICUT

BEFORE BUYING A TRANSFORMER

ASK YOURSELF THESE QUESTIONS

1 Can the transformer be installed indoors, at the load center, where voltage drop would be reduced and copper saved?

2 Will an indoor installation require an expensive fire-proof vault or fire wall?

3 Does the surrounding air contain impurities which might adversely affect transformer reliability and life?

4 Can lightning surges and switching transients reach the transformer, either direct or through the main supply transformer?

5 In a plant rearrangement later, is it likely that the transformer will be moved outdoors, or to some other indoor location?

6 How much maintenance will be required?

7 In an emergency, will the transformer handle sustained overloads?

8 Is there any chance that the transformer will sometime be partially or totally submerged in water?

Reg. U.S. Pat. Off.

GET THE RIGHT ANSWER WITH PYRANOL TRANSFORMERS

1 You can ***safely*** install Pyranol* transformers indoors. Never has one burned or contributed to a fire.

2 No vaults are required with Pyranol transformers. You can install them anywhere (even on the roof, in the basement, or on overhead beams), thus saving time, floor space, and construction materials.

3 Pressure-tight tanks protect the vital parts of Pyranol transformers from dust, dirt, fumes, dampness, and accidental damage.

4 Pyranol transformers have high impulse strength against voltage surges—permitting dependable protection by valve-type arresters.

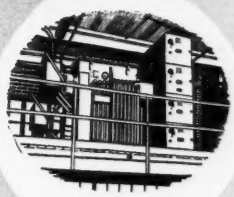
5 The completely sealed tanks of Pyranol transformers make any future change to an ***outdoor*** installation "a natural." Their inherent safety makes it possible to relocate them ***indoors*** anytime, anywhere.

6 Because dust, dirt, and moisture can't get into a Pyranol transformer, and since Pyranol is nonoxidizing and nonsludging, little or no maintenance is necessary.

7 The heat-storage capacity of the core-and-coils and of the cooling liquid make the Pyranol transformer ideal for sustained emergency overloads.

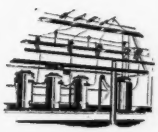
8 Pyranol transformers are pressure-tight. Even after three days' submersion in a torpedoed tanker, Pyranol transformers were found unharmed.

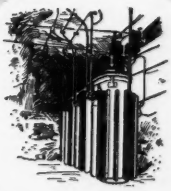
ON THE FACTORY FLOOR



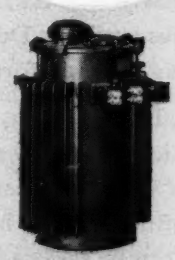
ON OVERHEAD BEAMS

ON ROOF TOPS





IN MINES



ALL-PURPOSE

PYRANOL TRANSFORMERS

For further information ask your G-E representative, or write for Bulletin GES-2974. ***General Electric Company, Schenectady, N. Y.***

BUY WAR BONDS

GENERAL ELECTRIC

402-61-5100

Before and After Pictures of Valves Reseated by
DEXTER EQUIPMENT

Look at the pictures on this page. The one marked BEFORE shows an 8-inch valve that *leaked badly.* The AFTER picture shows the same valve, reseated by Dexter Equipment to give it "good as new" performance.

With Dexter Valve Reseating Equipment, any mechanic can quickly and economically reseat *any* make of valve, whether it is made of monel, stainless, stellite, brass or bronze. More often than not, a valve can be reseated *without taking it off the line* . . . but in any case, when the job is done, seat and gate or disc become *pressure tight.*

Dexter Valve Reseating Equipment will pay for itself within the first few months of service in your plant. In addition to saving you money, it keeps production flowing and aids greatly in the conservation of vital metals at a time when new valves and parts are so difficult to obtain. Write for complete information today.

DEXTER
Valve Reseating Equipment
THE LEAVITT MACHINE COMPANY
409 EAST RIVER STREET, ORANGE, MASS.

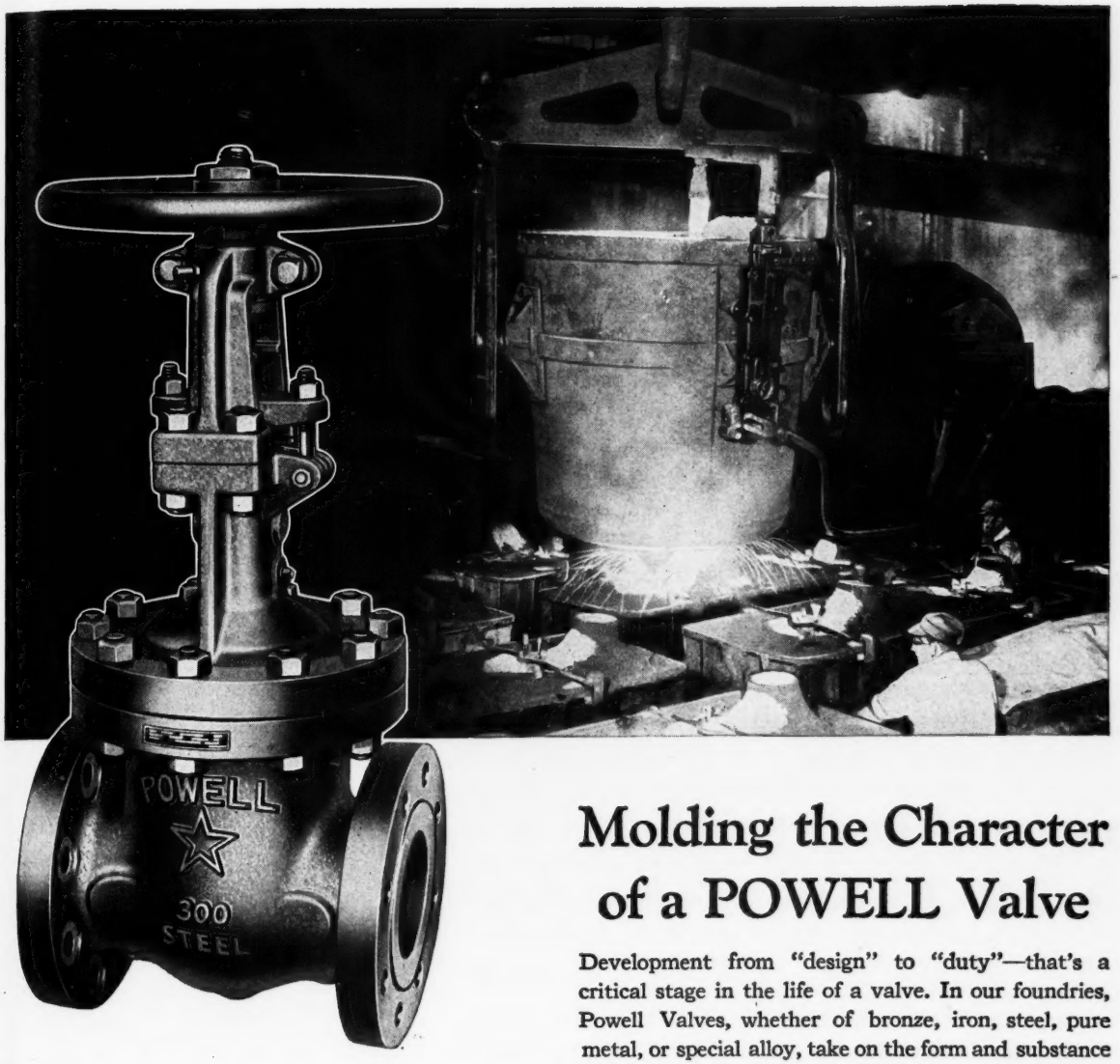


Fig. 3003—A Class 300 pound flanged end Cast Steel Gate Valve with outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Made in sizes 1" to 24", inclusive.

POWELL CAST ALLOY STEEL VALVES, for high pressure service, meet A. S. M. E. and A. P. I. Standards. They are made from regular cast steel valve patterns and are especially adapted, and used extensively, for high temperature, high pressure steam and high pressure boiler feed water lines. The designs also meet A. S. M. E. Boiler Code requirements. They are made to A. S. A. dimensions in the following pressure classes: 150, 300, 600, 900, 1500 and 2500 pounds.

Molding the Character of a POWELL Valve

Development from "design" to "duty"—that's a critical stage in the life of a valve. In our foundries, Powell Valves, whether of bronze, iron, steel, pure metal, or special alloy, take on the form and substance that Powell Engineering has pre-determined will best fit them to perform the duties for which they are destined. Here under the watchful care of experts are molded the character-istics that have earned for Powell Valves the designation "Standard for Control." That's why today many industrial leaders are turning to Powell for the solution of all their valve control problems.

The Wm. Powell Co.

Dependable Valves Since 1846

Cincinnati, Ohio

POWELL VALVES

No Wasted HOURS OF WATCHING

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

★ CUT ATTENDANCE TIME

★ BOOST OPERATING EFFICIENCY

★ SAVE COAL . . . OIL . . . GAS

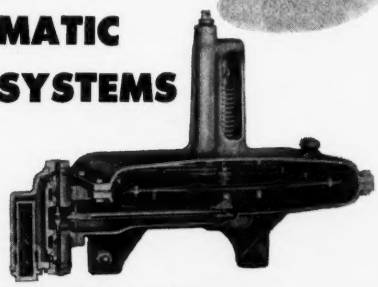
★ PRODUCE MORE HEAT FROM LESS FUEL

★ MAKE BOILERS STRETCH IN CAPACITY

● Attendants in your boiler room won't need to waste valuable time with control of air flow, of fuel feed, nor of draft. It's all done continuously and automatically with CASH STANDARD Automatic Combustion Control Systems . . . in plants as small as 60 h. p. or as large as they come.

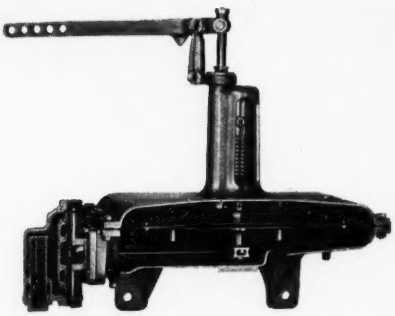
Each unit pictured here is available in numerous variations. Combinations of these units can be selected to best meet your requirements, whether you have a stoker, pulverizer, oil-burning, or gas-firing equipment on your boilers.

Bulletin No. 300 not only gives important details on the performance of each unit, but tells how the system which brings fuel savings and other benefits to your boiler room, can be assembled.



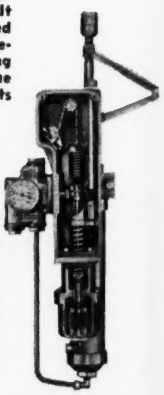
FURNACE DRAFT CONTROLLER

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.



AIR FLOW CONTROLLER

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

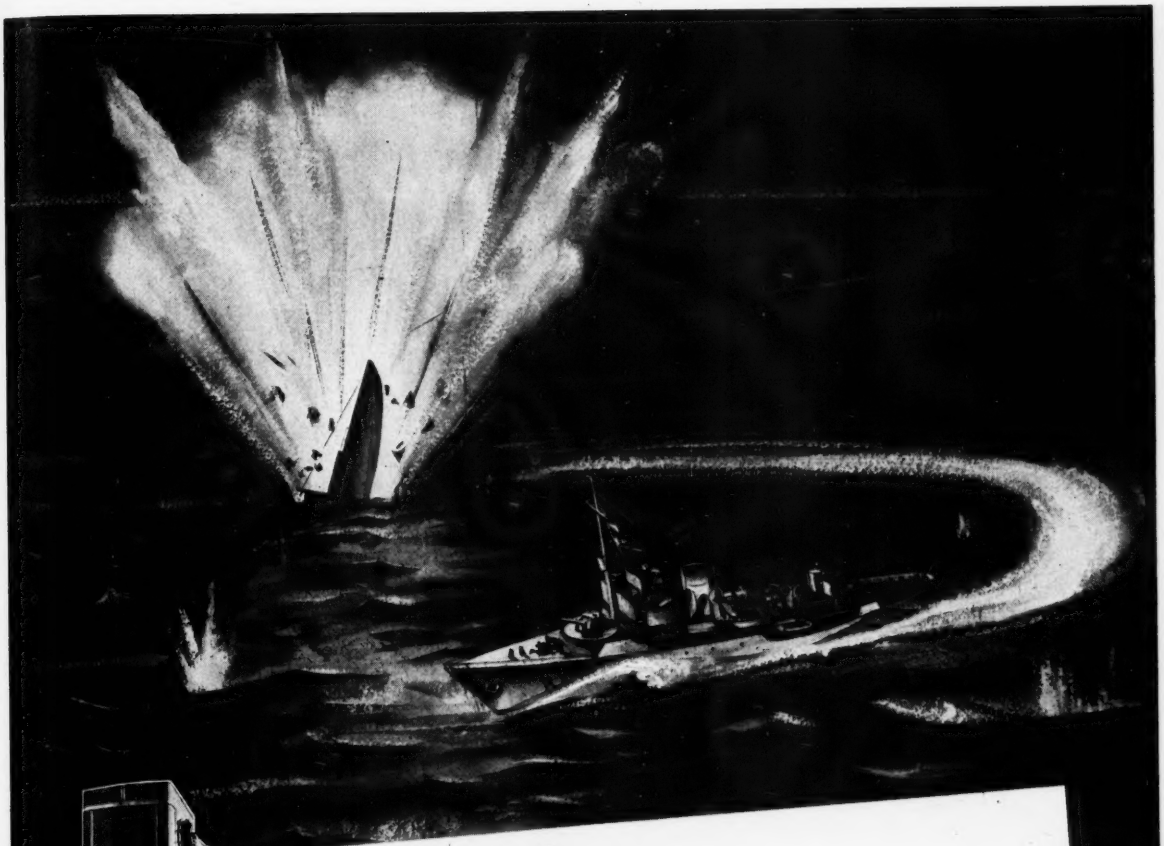


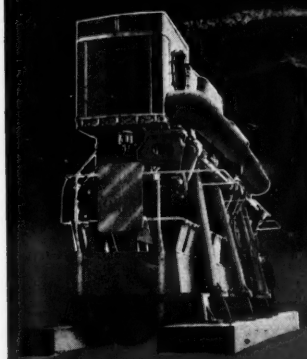
FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion — hence, money saving.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES





The Joint Fleet of HENDY are building reciprocating steam engines, for both the Navy's new, corvette escort vessels and Liberty ships; steam turbines and reduction gears for the larger cargo-carrying ships. These are all being manufactured in modern shops, built and fully equipped to produce large units in volume, by streamlined, mass-production methods.

Prelude to SAFETY OF THE SEAS..

This Jap sub had a "blind date" with one of the Navy's newest fighters but didn't know it until his inquiring periscope showed above the waves... then a quick pass... a terrific explosion... and there was one less sea marauder for the cargo ships to worry about.

That's the dramatic side of the war... the part that helps to inspire the entire Hendy organization to build the engines for these speedy escort craft... better and faster. There's a lot of drama too in building engines, especially when you are building for both fighting vessels and cargo ships. We like to think that every hour we save in the foundry, in the machine shop, or on the assembly line brings final victory that much closer... brings that day nearer when cargo ships will truly be the United States *Merchant* Marine, carrying peacetime products to every port in the world.

JOSHUA HENDY IRON WORKS

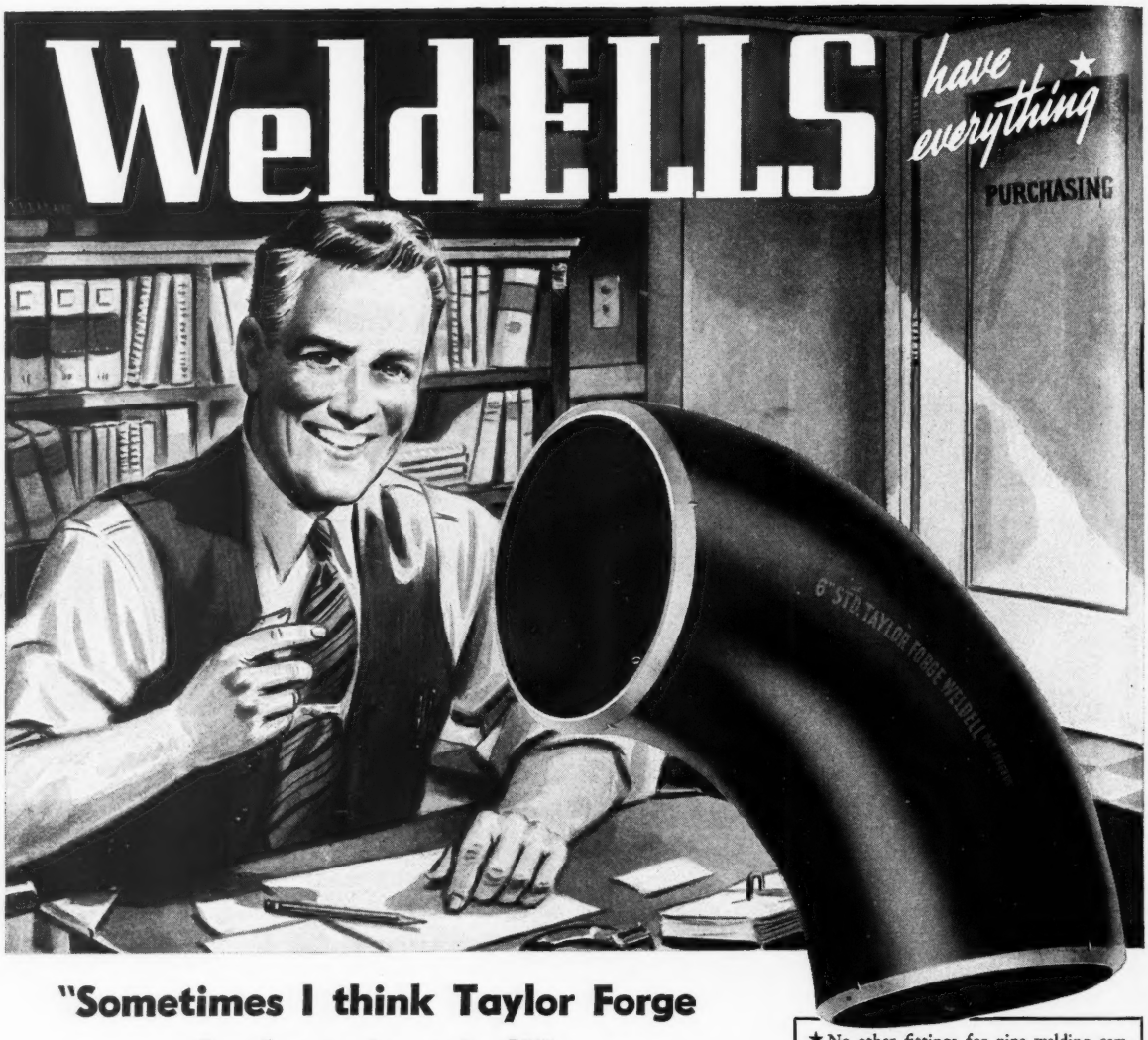
ESTABLISHED 1856

SUNNYVALE • CALIFORNIA

Divisions: POMONA PUMP COMPANY
CROCKER-WHEELER ELECTRIC MFG. CO.

Manufacturing Plants: SUNNYVALE, LONG BEACH, POMONA and TORRANCE in CALIFORNIA • AMPERE, N. J. • ST. LOUIS, MO.
Branch Offices: NEW YORK • WASHINGTON • PHILADELPHIA PITTSBURGH • CHICAGO • ST. LOUIS • SAN FRANCISCO • LOS ANGELES

WeldELLS have everything ★



"Sometimes I think Taylor Forge had me in mind!"

IN this purchasing job a fellow is always in the middle with pressure groups on all sides. So you can sure breathe a sigh of relief when you come across a product like WeldELLS* that pleases them all down the line!

Take the men who give first importance to engineering considerations: They like the reinforcement of the inner wall and they like the tangents that keep the welds away from the zone of greatest stress.

And then take the fellows who do the welding: They go for the practical features that make WeldELLS easy to work with — the quarter-markings; the clean bevels and lands; the tangents. They're strong for that Taylor Forge method of permanently marking the size and weight on every fitting, too.

Of course fittings that get the vote of both the engineer and the man on the job give us the best piping job and keep costs down. So you might know that makes WeldELLS ace high with the man who keeps the score and pays the bills.

Sometimes I think Taylor Forge had purchasing agents in mind when they gave their welding fitting *everything* . . . . for everybody!

★ No other fittings for pipe welding combine these features found in WeldELLS:

- **Seamless** — greater strength and uniformity.
- **Tangents** — keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement**—provides uniform strength.
- **Permanent and complete identification marking** — saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum** — assures full strength and long life.
- **Machine tool beveled ends** — provide best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

● The list of Taylor Forge's contributions to the war effort only begins with WeldELLS. One of many examples is Taylor Corrugated Marine Furnaces, essential to many merchant ships and transports.

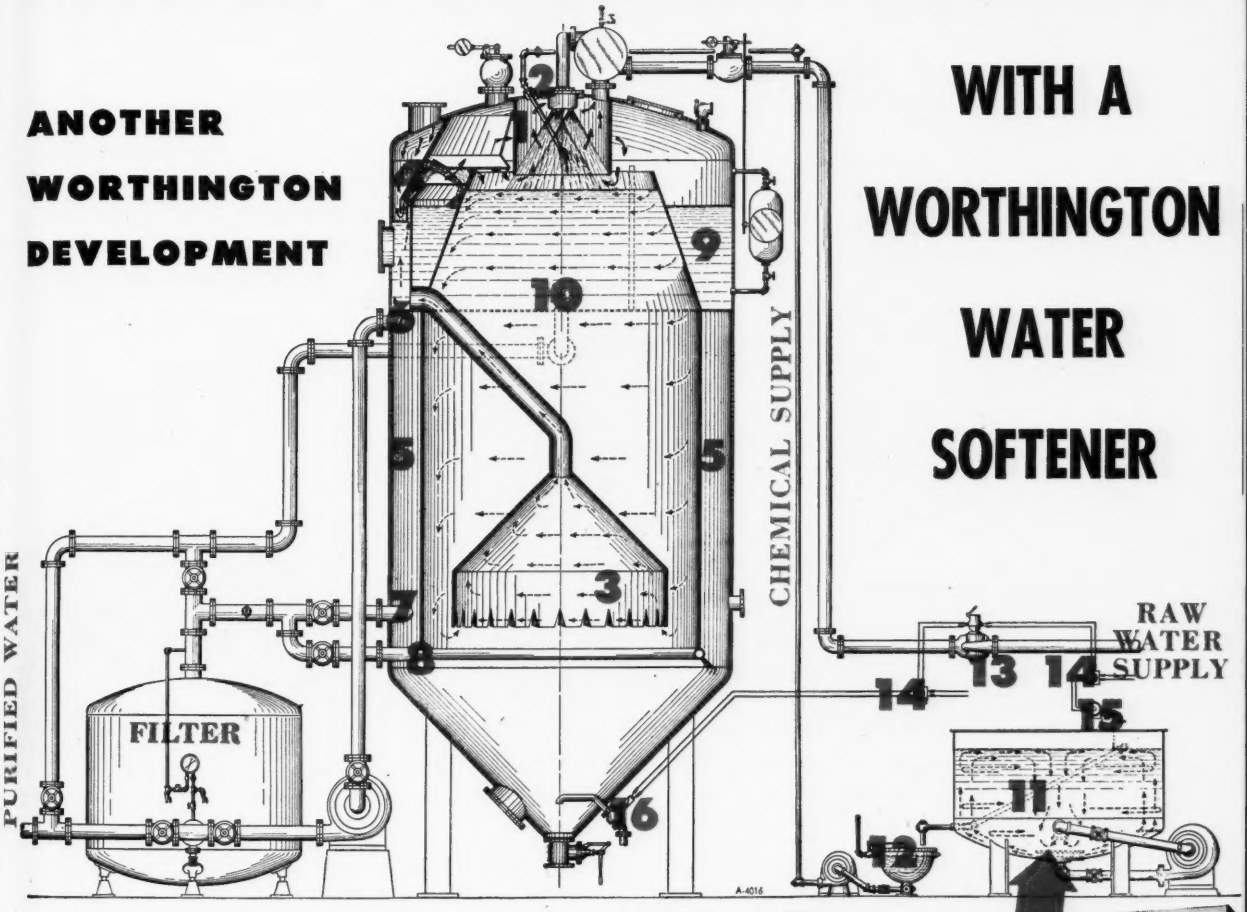
TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P. O. Box 485
NEW YORK OFFICE: 30 CHURCH ST. • PHILADELPHIA OFFICE: BROAD ST. STATION BUILDING

*WeldELLS and many other Taylor Forge products are produced in Byers Genuine Wrought Iron.

MAINTAIN *Uniform* WATER TREATING RESULTS

ANOTHER WORTHINGTON DEVELOPMENT

WITH A WORTHINGTON WATER SOFTENER



Check these features!

1. Primary Heater. Non-scaling. Efficiently heats the raw water and provides rotary mixing of water and chemicals.
2. Chemical Applicator. Removable. Sprays chemical through steam. Facilitates mixing and reaction.
3. Up-take Cone. Baffled serrations assure even draught. Increases softener capacity.
4. Deaerating Heater. Simple. Effective. Self-adjusting. No moving parts.
5. Wash Water Compartment. Backwashing operation separate from softening process. Disturbance of softening process by filter washing operation is avoided, permitting *uniformly* continuous operation.
6. Supply to Filter Wash Pump Suction.
7. Discharge of Dirt Laden Wash Water. Reclaimed by settling clear within 1½ hours.
8. Cleansing Ring. Provides uniform distribution of jets for washing softener precipitate and wash water sediment to central area of conical bottom.
9. Storage for Treated and Deaerated Water.
10. Treated and Deaerated Water Outlet to filters or direct to boiler feed pumps.
11. Chemical Agitator. (See above at right).
12. Chemical Dilution and Pump Suction Tank.

NOTE THE EXCLUSIVE CHEMICAL SUPPLY AGITATING SYSTEM

Circulation of liquid chemical supply through *stationary* diffuser maintains uniform chemical strength without use of moving parts within tank.

The value of this superior feature is indicated by the *uniform* quality of the treated water.

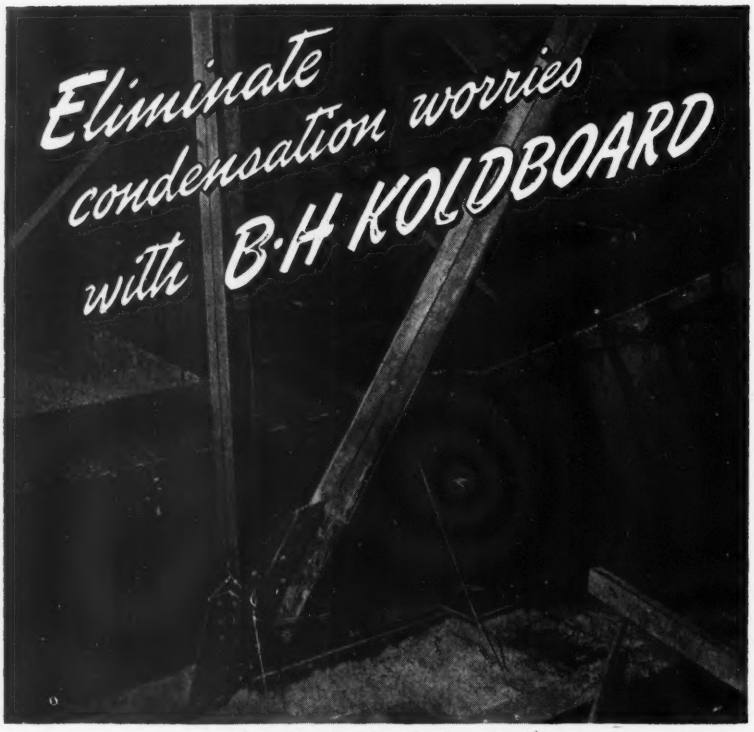
13. Proportioning Meter. Accurate. Low loss. Equipped with totalizing register.
14. Relays. Adjustable time interval.
15. Decanting Mechanism. Sturdy. Reliable. Accurate.
16. Sludge Remover. Removes sludge in proportion to its rate of formation.

For full details Bulletin W-212-B2 is available at district offices (in all principal cities) or at headquarters.

W83-1

WORTHINGTON

WORTHINGTON PUMP & MACHINERY CORPORATION • GENERAL OFFICES: HARRISON, N. J.



Air-conditioning ducts in the attic of a large theatre. The Koldboard was applied directly to the duct surface and held in place by 16 gauge wire. All joints sealed with hot asphalt.

Condensation difficulties which occur in low temperature ducts can be eliminated by the use of B-H Koldboard. Made from B-H *Black* Rock-Wool, Koldboard is moisture repellent, chemically stable, and non-combustible—the perfect combination for maximum insulating efficiency. The fibres are felted and bonded together to form flat, semi-rigid blocks.

Effective for temperature ranges from −150° to 300° F it provides ideal low temperature insulation for cold storage rooms, air-conditioning ducts, refrigerators, roof insulation, marine bulk heads, ship hulls, etc. Tests by well-known testing laboratory show that B-H Koldboard has a thermal conductivity of 0.32 BTU/sq. ft./hr./° F at a mean temperature of 75° F.

Send for a generous size sample of B-H Koldboard and copy of current catalog.

BALDWIN-HILL INSULATIONS BH

BALDWIN-HILL COMPANY

577 KLAGG AVE. • TRENTON 2, N. J.

NEW YORK, N. Y. • CHICAGO, ILL. • KALAMAZOO, MICH. • HUNTINGTON, IND.

The Role of Capacitors in War Work

(*Continued from Page* 114)

voltage is equal to the vector sum of the capacitor and welder voltages. If a capacitor is to be added directly to an existing welder, the circuit voltage must be substantially raised. By rewinding the welder, the combination may be matched up with the existing supply voltage. Both methods require careful coordination of the capacitor and welder units; it is also necessary to know the welder transformer characteristics and give each machine separate consideration. Individual series capacitors of this kind now make it possible to use welders on circuits on which they formerly could not be used.

This article deals specifically with cases where power factor is raised to remove wattless current from utility systems. Obviously, many instances will be found where a capacitor will also benefit the utility customer. A few ways are given wherein a customer can benefit from a capacitor installation.

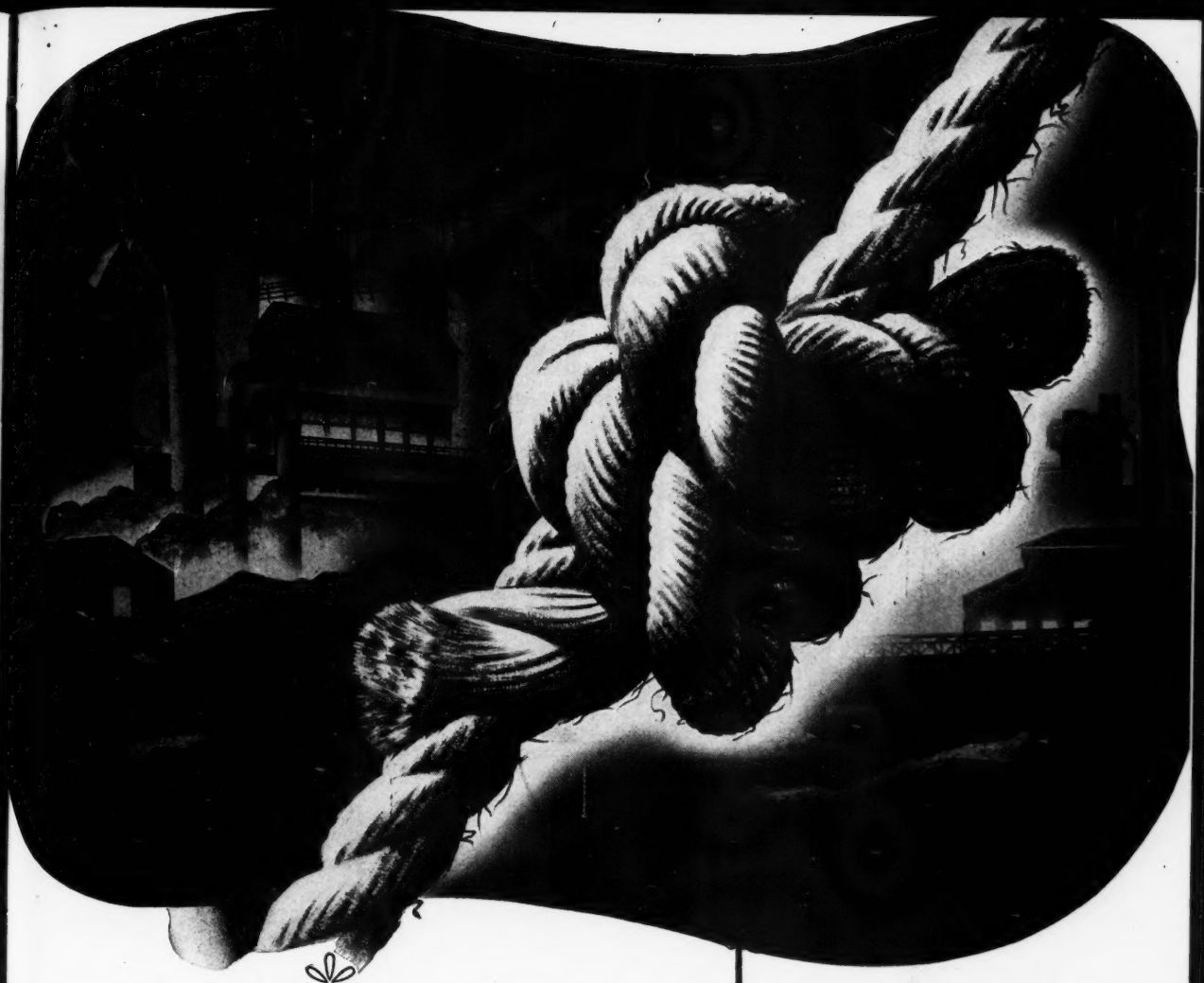
(1) The same bank of transformers will handle additional burden if the power factor is raised by capacitors on the load side of these transformers.

(2) Plant circuits will handle additional current without overheating if capacitors are added to existing and future loads.

(3) Additional current can be handled on existing bus duct installations, overheated ducts can be relieved, by placing capacitors at proper points along the duct or near the load.

(4) Voltage can be raised to a satisfactory level at the end of plant feeders, where excessive drops now exist. Capacitors are useful in counteracting the effect of high inductive reactance as is found in open wired circuits.

It has been estimated that 2,000,000 to 2,500,000 kva of capacitors were installed in 1942. This permits power systems to handle 650,000 to 850,000 additional kva because the capacitors have removed part of the old wattless burden. Thus capacitors play an important role in the present emergency and the quantity of critical material used is relatively small compared with that required by alternate methods. Where power factors are low on fully loaded circuits, capacitors provide a most logical method of supplying additional capacity.



How O.S. untied a knot in a steel mill turbine

IF THERE'S a tougher type of turbine to lubricate than a turbo blower in a steel mill, we haven't heard about it. No wonder one of the country's large steel producers couldn't get turbine oil to last longer than 6 months!

But in November, 1940, this manufacturer filled one of its turbo blowers with the then new Shell Turbo Oil. The phenomenal result is shown at right. After 18,553 hrs. of operation Shell Turbo Oil still shows no signs of deterioration. This performance is the reason Shell Turbo Oil is now used in 14 turbines of this steel company.

For further details on this and other outstanding performances of Shell Turbo Oil call in the Shell man. Or, write Shell Oil Company, Inc., Dept. "C," 50 W. 50th St., New York, N. Y., or 100 Bush St., San Francisco, Cal.

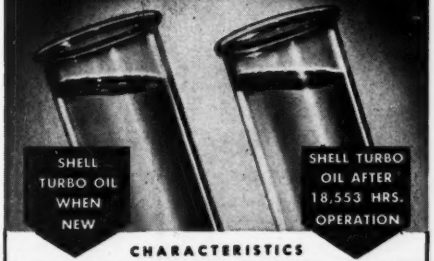
SHELL TURBO OIL

Currently, the U. S. Navy has first call on Shell's entire production of marine turbine oil.

CERTIFIED PROOF OF THE SUPERIOR

OXIDATION STABILITY

OF SHELL TURBO OIL



CHARACTERISTICS		
156	*Viscosity @ 100° F.*	156
Clear	*Appearance*	Clear
.05	*Neutralization No.*	.05
.1	*Saponification No.*	.2
90	*Steam Emulsion No.*	90

Performance record of Shell Turbo Oil in one of the fourteen units of a large steel producer.

HERE'S THE *Short cut* TO

FYR-FEEDER
MULTIPLE SPREADER STOKERS
BURN COAL LIKE OIL!

Higher Steam Capacity

NEED MORE STEAM? The quick and economical solution is to install multiple **FYR-FEEDER** stokers in present boilers to get higher capacity . . . higher coal burning efficiency . . . and lower fuel costs which assure a high return on the investment. Here are the facts on the multiple **FYR-FEEDER:**

Burn Any Coal, screenings or sweepings, you have available locally; any bituminous coal, any melting point of ash, free-burning or coking coals.

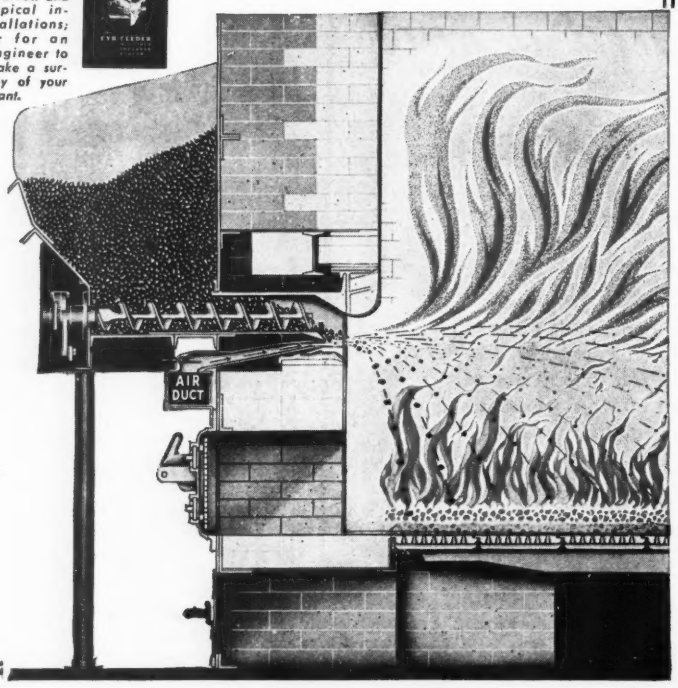
FYR-FEEDER Burns Coal Like Oil. Burns fines in suspension, burns larger pieces on grate. Coal is spread over entire fuel bed, with greater active coal burning area. Thin fuel bed, no clinkers. Fires can be cleaned in two minutes.

Quick Delivery. Priorities are being granted to plants requiring additional steam generating capacity; and we can make Quick Delivery. Multiple **FYR-FEEDER** stokers can be installed in large or small boilers with minimum loss of production time.

AMERICAN COAL BURNER COMPANY

WRITE FOR CATALOG *describing features, operation and typical installations; or for an engineer to make a survey of your plant.*

22-18 E. Erie St., Chicago 11, Illinois



Brief Company Statements on Training of Operators

(*Continued from Page* 110)

COMMONWEALTH EDISON COMPANY
CHICAGO, ILL.

AS MAY BE EXPECTED, whatever training plans we may have used in the past, they have been badly upset under present conditions. In the first place, we have been rather selective in the men employed for generating station work and have made it a practice to start them in at the bottom of the ladder.

Classes in a great variety of subjects are maintained by the company free of expense to the employees. In addition the company pays one-half of the expense of acceptable courses in recognized educational institutions. The practical training on the job is pretty generally left to the supervisors, and in the more important operating positions, examinations are held before promotions are made.

In the new high-pressure boiler plant installations, we have found it advisable to prepare a manual for each installation, and classes are regularly held before the equipment is put in service. These classes are open not only to men who are ready for promotion, but to engineers and other supervisors.

So far we have not found it necessary to use women in any of the generating stations, except for office work.

ALEX D. BAILEY,
Assistant to Vice-President

PENNSYLVANIA WATER & POWER COMPANY
BALTIMORE, MD.

OUR PLAN OF OBTAINING and training operating personnel as used in two fair-sized hydro plants (Holtwood and Safe Harbor), and a small steam plant, is based on hiring high school graduates shortly out of school. These young men are given the lowest position on the operating ladder, i.e., in the hydro plants the position as apprentice or second pumpman. They are gradually advanced through the operating positions of the hydraulic division of the company (first pumpman, governorman) until they are transferred to the electrical division, where they can advance from the grade of machineman to second and first assistant operator, and finally operator in charge of the whole plant.

Such advance usually requires six years or more. The system has the advantage that when a man reaches the top position in full charge of the hydraulic and electrical divisions, he has a thorough knowledge of everything that affects the operation of the whole plant.

The training is carried out largely by the man's immediate supervisor, and by the chief operator of the station, who at frequent intervals examines the progress of the man in question both with regard to his ability to carry out the routine jobs pertaining to his work.

BEFORE YOU SPECIFY A VALVE
Make Sure It is the One You Need

TODAY, when it is more important than ever before to keep pipe lines flowing at maximum efficiency, too much care cannot be given to selecting the right valve for each job. Before you "draft" a valve for that all-important line, make sure it is the one you really need.

Here is the answer to a frequently-asked question on valve selection, taken from the files of The Kennedy Valve Manufacturing Co. Other problems will be considered in succeeding advertisements in this series.

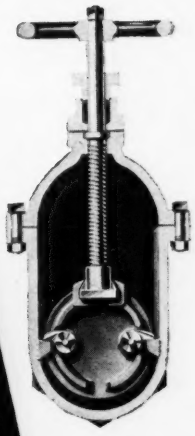


Fig. 2

Question:

SHOULD YOU USE VALVES THAT SHOW AT A GLANCE WHETHER THEY ARE OPEN OR CLOSED?

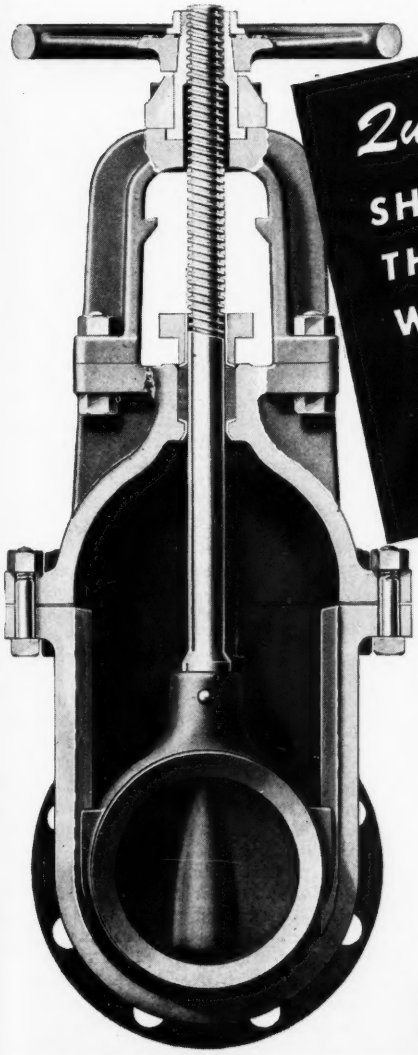


Fig. 1

Answer:

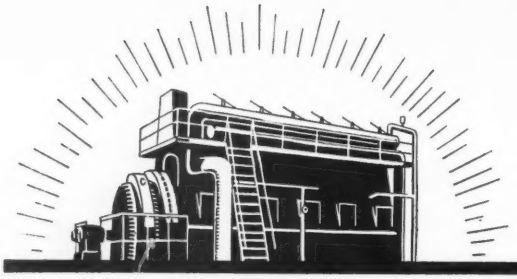
The rising-stem of outside-screw-and-yoke gate valves provides visual indication of disc position (see figure 1). Whether or not this construction should be chosen depends on installation conditions and the fluid being handled. Rising stems require more headroom, and the external threads are exposed to atmospheric conditions, although this is not a serious drawback in most cases as the threads are easy to lubricate. Non-rising stems (see figure 2) do not require additional headroom but, because disc position is not apparent to the eye, excessive operating strains may result from attempting to turn the handwheel in the wrong direction. The outside screw is preferable with corrosive fluids because the stem threads are out of contact with the substance handled.

If you have a valve selection problem, write to us. As Kennedy makes a complete line of standard gate, globe, angle and check valves, you can be sure of receiving unbiased help. For full description of Kennedy valves, pipe fittings and fire hydrants, send for 240-page Kennedy Catalog.

KENNEDY

VALVES • PIPE FITTINGS • FIRE HYDRANTS

THE KENNEDY VALVE MFG. CO. • ELMIRA, N. Y.



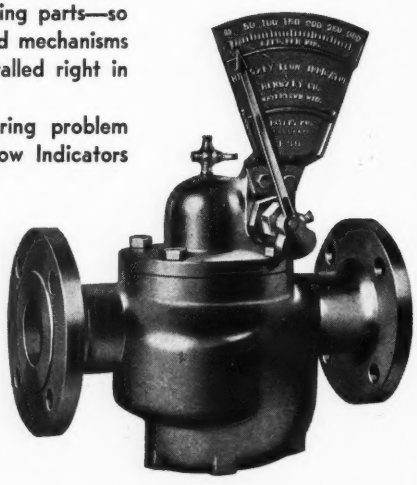
to keep those MIGHTY DIESELS HUMMING SMOOTHLY

Accurate measurement of the flow of lubricating oil is one of the many small but highly important jobs that are necessary to keep Diesel engines perking along at peak performance.

HENSZEY FLOW INDICATORS

have proved to be ideal for measuring the flow of those lubricating oils. They accurately register the rate of flow from zero to 100%. The graduations on the dial are uniformly spaced from one end to another and read direct—without constants. A long useful life, even under today's twenty-four hour schedules, is assured by the all-around rugged construction of every Henszey Flow Indicator. There are only three moving parts—so breakdowns due to complicated mechanisms are eliminated. It can be installed right in the pipe line.

Whatever your flow measuring problem may be—consider Henszey Flow Indicators for the job. Installations are satisfactorily performing in nationally known paper mills, chemical plants, petroleum refineries, milk condenseries, and many other war industries.



Send for New Bulletin FI-1.

HENSZEY CO.

Dept. C9

Watertown, Wis.

HENSZEY

FLOW INDICATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Boiler Feed Regulators • Proportioning Valves

Monthly or bi-monthly meetings are held with each of the operating shifts, under the supervision of the chief operator, to discuss past disturbances and go over particular instructions warranted by the season of the year, for instance, ice and sleet at the approach of the winter.

A similar advance from the coal preparation plant through the boiler room to the turbine hall is used in the steam plant. Since it is not possible at the present time to obtain high school graduates, we have so far managed by increasing the working hours both for operators and maintenance men from 40 to 48 per week, and by training a number of maintenance and some office and test engineers for work in the lower positions of operation in emergency.

So far we have used women only in laboratory work, but not yet for power plant operation.

A. F. Bang,
Supt. of Operation

Jones & Laughlin Steel Corporation
Aliquippa, Pa.

Two years ago questions from the operating personnel of our boiler and power plants indicated a desire of the operators to know more about the technical features of their jobs. When men that were unschooled in the art of obtaining self-directed knowledge were confused and discouraged by textbooks and handbooks, we realized that we should direct their efforts by use of organized classes.

Although the men were ready to attend classes at night on their own time, they were bewildered by the requirements of the established night courses presented by the available technical schools. They became more interested when we selected an official of our own plant who was familiar with their jobs to act as instructor. That instructor planned his course to eliminate as much unrelated theory as possible, but to give the employee the necessary basic knowledge.

Just enough chemistry was given to enable the class to determine the amount of air required and the final products in the combustion of a pound of fuel. Just enough physics to enable them to determine the delivery of a pump. And just enough mathematics to enable them to determine the thermal efficiency of a turbine generator. These were followed by discussions of the features of our own particular boilers, turbines, etc.

That particular course lasted for 15 weeks of two 3-hr periods each. It was followed by a similar course of more advanced combustion and furnace design for those that were interested. Subsequent to the completion of the second course those that were capable of doing so enrolled in a night course of Instrument Maintenance and Electronics at one of the nearby technical universities.

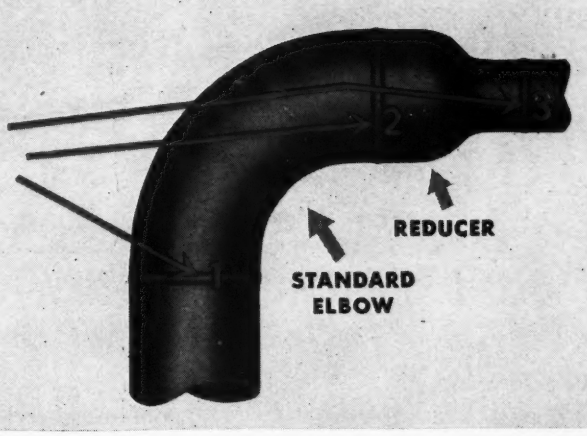
We have not found it necessary to employ women in our power plants yet.

D. W. Whitehill,
Asst. Supt. Steam Dept.

WHY MAKE

THREE Welds

WHEN



YOU CAN GET A

Better Piping Job

WITH **TWO?**

In a welded pipe line when it is necessary to change both direction and pipe size, the Midwest Reducing Elbow will take the place of two welding fittings: (1) a standard elbow and (2) a reducer. The result will be the elimination of one weld, a reduction in cost of the welding fittings, a saving in erection time and expense, and improved appearance.

Midwest Reducing Elbows have all the advantages of Midwest Standard Elbows: unusual dimensional accuracy and uniformity, beneficial effect of working the metal in compression, stress relieving, etc. They have the same center-to-end dimensions as standard elbows with which they are interchangeable.

The Reducing Elbow is one of the many Midwest developments that have added greatly to the design improvement and the time- and money-saving possibilities of welded piping systems. See Bulletin WF-41 for complete information.

MIDWEST PIPING & SUPPLY COMPANY, Inc.

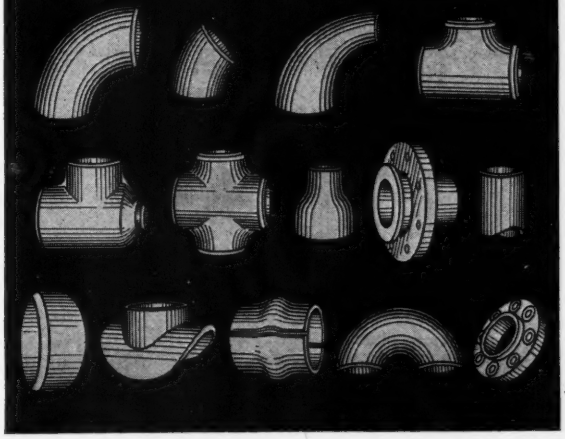
Main Office: 1450 South Second St., St. Louis, Mo.

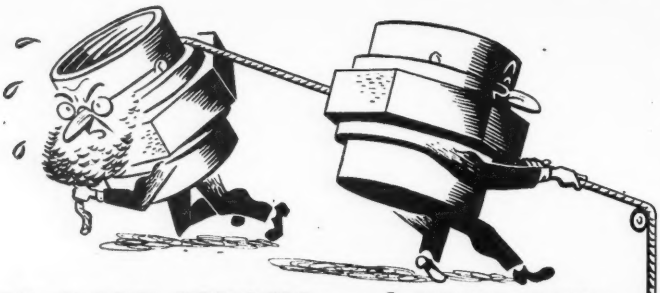
Plants: St. Louis, Passaic (N.J.) and Los Angeles

Sales Offices: Chicago—645 Marquette Bldg. • Houston—229 Shell Bldg.
Los Angeles—520 Anderson Street • Tulsa—533 Mayo Bldg.
New York—(Eastern Division) 30 Church Street

MIDWEST

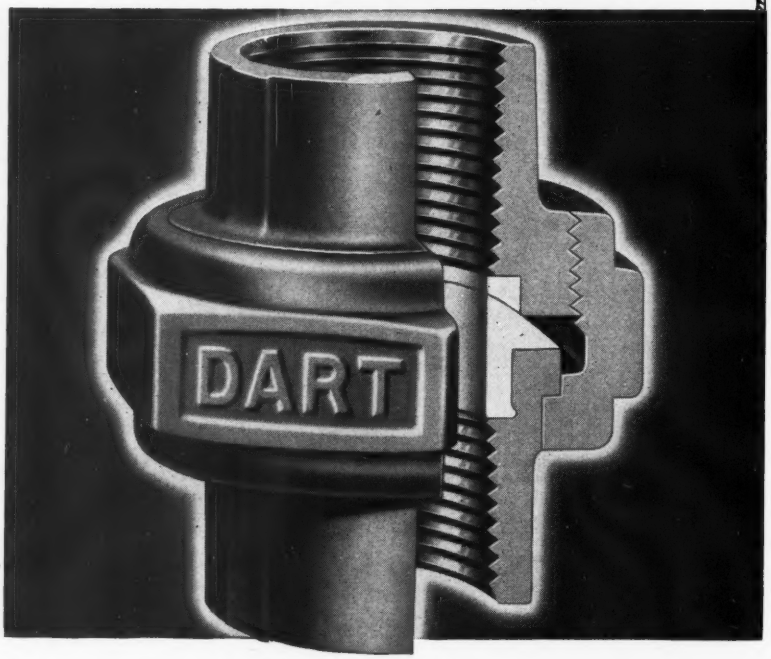
WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS





OLD DART UNIONS and NEW ONES

PULL TOGETHER FOR VICTORY



...Put Your USED DARTS Back to Work

Old Dart Unions can *pull their weight* along-side *new* ones in the tug-of-*war-production*. For, even though a Dart Union has been used over and over again, it is still capable of going back to work and giving dependable, *tight-joint* performance.

There are good solid reasons why Dart Unions can offer such extra dividends in long life and trouble-free performance. Here is one reason: Dart's matched bronze inserted seats are precision machined and ground to an accurate true-ball joint. *And:* Dart bodies and nuts are extra heavy, made of air-refined malleable iron that resists corrosion, pipe strains and wrench abuse.

So, locate your old Dart Unions and let them *pull together* with the new Darts you get from your supplier.

DART UNIONS

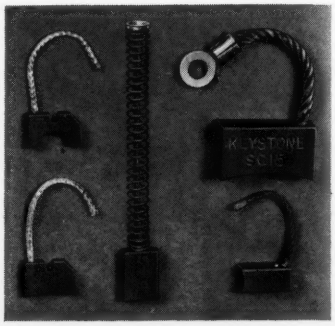
E. M. DART MANUFACTURING CO., PROVIDENCE, R. I.

NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. WRITE TO POWER PLANT ENGINEERING

Graphite Brushes

NEW GRADES of brushes for ring and commutator applications have been developed for the aviation and electrical industries by Keystone Carbon Co., St. Marys, Pa. These brushes are made in various grades of copper-graphite and silver-copper-graphite.



Some types were developed specifically for current control apparatus where extreme precision is vital. The shunts are moulded into the brush and establish a perfect connection. Low contact drop, high current carrying capacity and a low coefficient of friction are characteristics of these brushes.

Rechargeable Flashlight Battery

DUE TO THE 50 per cent cut in the production of dry cells for flashlights ordered by WPB, the Ideal Commutator Dresser Co., Sycamore, Ill., announces that its rechargeable storage battery is now fast proving its value wherever flashlights are required in regular use.

Although this battery is small in size, made to fit all popular two cell, 1¼ in. size D flashlight cases, it has proved through actual heavy duty service to be dependable, long-lived and economical. It is said that each battery can replace up to 400 or more dry cells by merely recharging at convenient periods. Battery chargers for this purpose are available both in single and gang types for use on both alternating and direct current.

READY! Simplified Catalog of G-E Renewal Parts

HELPS GET PARTS FASTER

- ✓ Quickly identifies needed parts—pictorially!
- ✓ Simplifies ordering by catalog number
- ✓ Speeds delivery from G-E warehouses or factories
- ✓ Gives dimensions, descriptions, prices on all parts required most frequently
- ✓ Includes parts for G-E motors, control, switchgear and other widely used electric equipment; also supplies, such as magnet wire, insulating materials
- ✓ Makes it easier to order *genuine* G-E parts, for better fit and long-lasting performance

NOW, a single book—indexed for easy reference—can take the place of separate handbooks and bulletins for identifying and ordering most G-E renewal parts needed to keep your equipment in operation. With this book, you'll find it easier to order genuine G-E parts *by catalog number*—saving time all along the line.

For your copy, just mail the coupon. Even though you don't need it now, it may save precious hours in an emergency. *General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC

General Electric Co., Section W750-220
Schenectady, N. Y.

Yes, I want a copy of your new 96-page catalog "Renewal Parts and Supplies (GEA-638)" to help simplify ordering of genuine G-E parts.

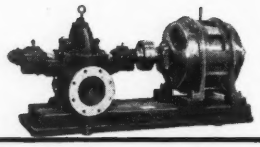
Name.....

Company.....

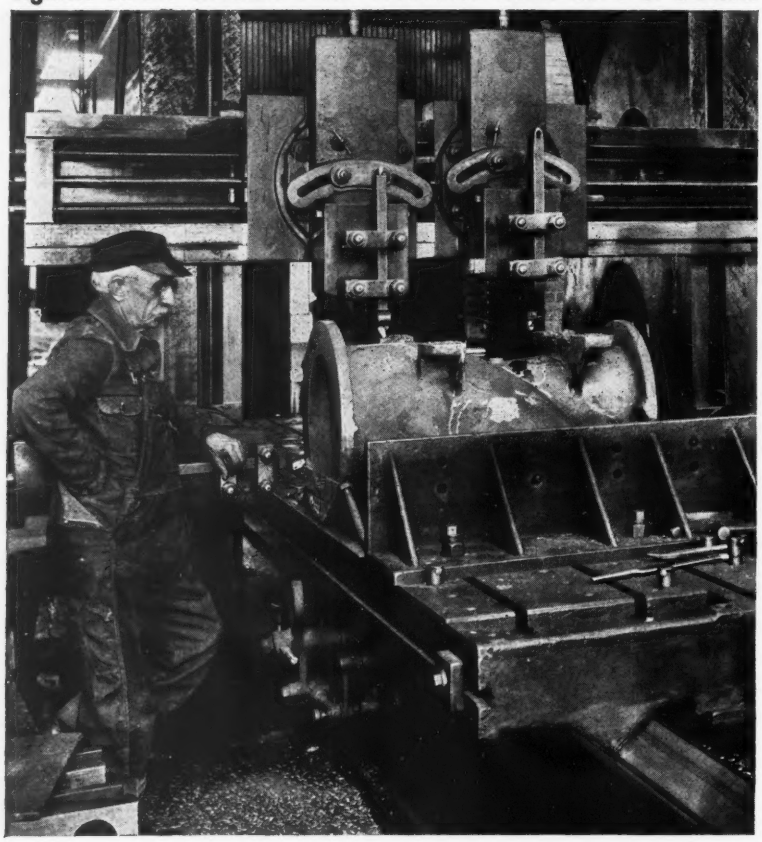
Address.....

City.....State.....

225



Fighters on the WARREN PUMP Production Front. No. 6 of a Series



MAESTRO OF THE PLANER . . .

MASTER OF MANY JOBS . . .

CHARLIE GARDNER

Charlie Gardner is a Warren Pump Company planer operator, *par excellence*. He *has* been one for many years. But Charlie is also handy at operating other machines, such as large horizontal and large vertical boring mills . . . and has had many years of machine shop experience, as well. The reputation that Warren Pumps have *always* enjoyed for efficiency, reliability, and economy would not have been possible without the skill, experience and "pride of workmanship" that Charlie Gardner and other Warren employees have always possessed to such a high degree. And those Warren employees who are not in the armed services now, are giving *all* their energies and skill to make the Warren Pumps that will fight *for them on every front*, to help bring Victory.

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC.
WARREN, MASSACHUSETTS

Wood Grille Barrier

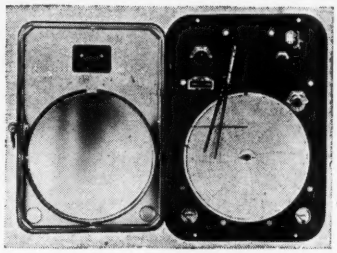
EXPERIMENTAL WORK has been completed by Cornell Iron Works, Inc., Long Island City, N. Y., on rolling wood grille bars strung on light steel tapes operating up and down in wood guides. The design uses the minimum amount of critical material. The wood rolling grille coils overhead on a horizontal counterbalancing shaft, giving the same operation as the rolling steel grille. No wall or floor space is taken up, as the coil is entirely overhead and out of the way.

The rolling wood grille makes a substantial barrier and can be fabricated for opening widths up to 19 feet and opening heights unlimited. Operation is either push up, or for larger sizes, by hand chain or electric motor.

The wood rolling grille locks into the side guide with a padlock and hasp on the bottom bar. It offers the advantage of being replaceable with a rolling steel grille at a later date if desired.

Air-operated Controller

A NEW air-operated automatic control instrument, known as Convertible Free-Vane Controller, made for automatically controlling temperature up to 3600 deg. F. flow, liquid level, pressure, draft humidity, pH value, and time program has just been announced by The Bristol Co., Waterbury, Conn. It operates on the same basic Free-Vane principle as that used in previous models offered by the company. A number of design refinements have been incorporated, which simplify the instrument and make it more convenient to service. The new instrument is also designed so that the user can convert from one type of control system to another.



The Convertible Air-Operated Controller is offered in the following types: Monoset (On and Off), Ampliset (Throttling), Preset, Reset, and Magniset. Adjustments for fitting the controller to the requirements of the process are located on a dial board above the chart.

Portable Gasoline Driven Generator

A NEW PORTABLE gasoline driven generator for rapid battery charging has been announced by Hunter-Hartman Corp., St. Louis, Missouri. It is said that this new unit will eliminate many of the problems accompanying the use of storage batteries in operations where electric current and conventional equipment for charging are not conveniently available. The manufacturer calls attention to the fact that this equipment is available only on priority rating of AA5 or better.

The unit is designed to charge 6, 12 and 24 v batteries at 10 to 300 amp and consists of a specially designed generator driven by a 6 hp single cylinder, air cooled, gasoline engine equipped with air

Just as undue wear on auto tires results when the wheels are out of alignment, so unnecessary wear is caused on valve parts when they are not perfectly aligned.

Perfect alignment of all parts of Fairbanks Valve U-Ol is assured by the radial seat when valve is taken apart to replace a worn disc. Without sliding or scraping of the surfaces of the seat, the radial seat is drawn to a tight joint by a Union nut. This increases the life of the valve and assures a tight body joint after every assembly.

The slid-on disc holder is so guided that it will not bind or stick regardless of position of valve. The design of the disc nut tends to throttle the action against the disc, thereby prolonging its life. Disc rings of any make will fit into the disc holder.

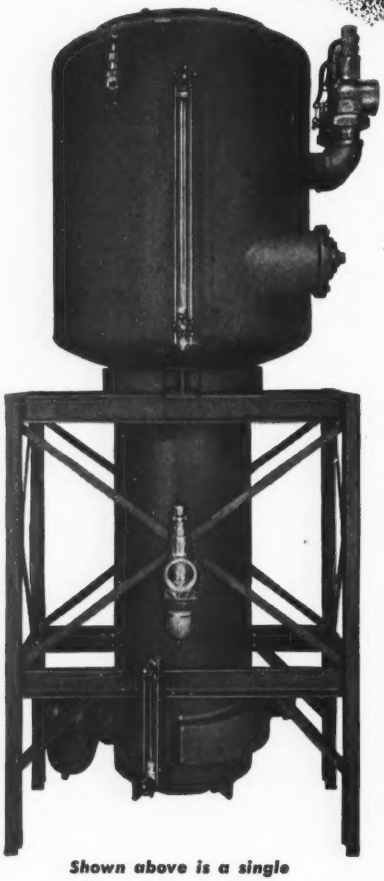
You can "Bank on Fairbanks Valves" for dependable service, long life and low maintenance cost.

Write for catalog No. 42 and name of our nearest distributor.

THE FAIRBANKS COMPANY
393 Lafayette St., New York, N. Y.
Boston, Mass. Pittsburgh, Pa.
Distributors in Principal Cities.

Fairbanks *Standard and* Renewable **Valves**

PURE WATER... INEXPENSIVELY



Shown above is a single effect of a typical Henszey Distillation System.

The *supply* of water is not usually a problem but the *quality* of the available water usually is. That is because the high salt content renders some water supplies unfit for industrial processing—for boiler feed water—and for human consumption.

HENSZEY DISTILLATION SYSTEMS

provide an abundant supply of absolutely pure water—and at a low cost, because the Henszey unit gives six effect efficiency with only three evaporator effects. Fuel consumption is cut in half. Installation space requirements are held at a minimum.

If you are the man whose job it will be to provide pure water for power production—for industrial processing—or for human consumption—you should know more about Henszey Distillation Systems.

HENSZEY CO. Dept. C9, Watertown, Wis.

HENSZEY

DISTILLATION SYSTEMS

Continuous Blowdown • Heat Exchangers • Boiler Feed Regulators
Feed Water Meters • Flow Indicators • Proportioning Valves

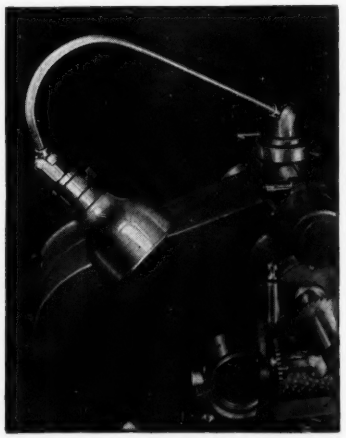
Portable Gasoline Engine Driven Generator

cleaner, gasoline filter, magneto, self-starter, rope starter, gas tank and remote stop control. The entire unit is mounted on a skid-type base, equipped with 5 in. wheels.

This equipment is said to be of great value in airplane factories and around airports for starting motors as well as charging batteries and operators of commercial vehicles and large industrial plants are said to have made substantial reductions in equipment hours lost through battery failures as well as definite economies in servicing costs. The unit can also be used as a direct current lighting plant with output range from 1000 to 3000 watts.

Work-Lites

To GIVE MORE light for more production required by close tolerance and close assembly work, Reliance Devices Co., Inc., 510 Sixth Ave., New York City, announces a new line of Swivelier machine-lighting units which can be attached to machines, walls, ceilings, work benches, drafting boards, assembly tables, etc.



These units are said to be unaffected by machine vibration, having a patented spring construction inside Swivel base and Swivel socket, are adjustable to a 350 deg horizontal plane and 90 deg vertical plane at any angle. Wire is completely enclosed in the unit and there are no set screws or wing nuts to adjust. These Work-Lites are available in a wide range of arm lengths and with three types of shades, attached to uno-thread socket. They may be obtained in base and socket combinations, with switch in base and keyless socket or switchless base and key socket.

Announcing

NEW

BUYING DATA

THAT REDUCES MOTOR AND CONTROL SELECTION AND ORDERING TIME 1/2

SIMPLIFIED

FOR QUICKER SELECTION . . . EASIER ORDERING . . . QUICKER DELIVERY

Westinghouse takes pride in introducing new, simplified Buying Data, which enables you to select and purchase the proper motor and control for your job—in one-half the time!

Data, as presented, is striking in its newness. It's easier to read, easier to understand, and easier to use than any offered previously by any manufacturer.

To fit widely varying requirements, this radically new Buying Data is available in two forms:

- **Bound books** are suitable for use of the majority of motor and control buyers. They contain prices (correct at time of issue and satisfactory for estimating purposes throughout the books' life), dimensions, application data and descriptions. They include the following:

  "Motor Buying Data" covers popular types and ratings of Motors (up to 100 hp), Gearmotors and M-G Sets.

  "Control Buying Data" lists a wide variety of controllers and accessories for direct current, single-phase, squirrel-cage and wound rotor motors.

- **Motor and Control Loose-Leaf Book.** This is for the use of large-scale purchasers and is "tailored" to meet the needs of the individual buyer. Pricing data is always kept up to date by the issuance of new price supplements.

HERE'S HOW TO GET THIS NEW BUYING DATA

If you are a buyer of Motors and Control, chances are you have already received this new data by mail.

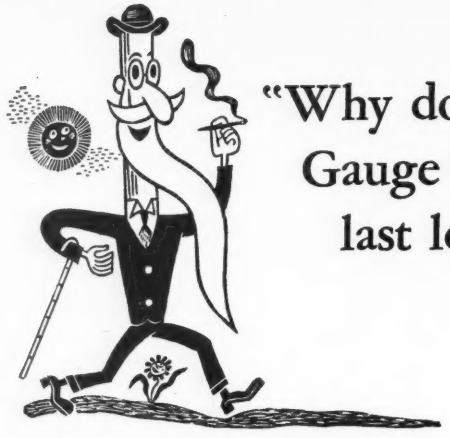
However, if you have not received your copy, write, wire or phone your nearest Westinghouse district office (distribution will be made through district offices only—no mailings from Westinghouse Headquarters at East Pittsburgh). Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

J-90485

Westinghouse *Motors and Control*

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

A reproduction from an actual unretouched color photograph which illustrates the appearance of the gauge glass from directly in front.



"Why do Pyrex Gauge Glasses last longer"

That question is so often asked that the answers may be of general interest to plant engineers and operators.

Few people realize how many different kinds of glass can be made, or how many different characteristics it can have. Corning has made over 25,000 varieties—makes 700 regularly. One of these is a composition specially suited for gauge glass service.

This particular type is a PYREX brand Borosilicate Glass with an extremely low co-efficient of expansion (.0000032 between 34° and 700° Fahrenheit). Capable of being heated to 600° F. and plunged into ice water repeatedly, without damage, it is completely indifferent to all ordinary plant temperatures.

Furthermore, this PYREX brand Glass is extraordinarily resistant to corrosion. Under constant boiling in concentrated sulphuric or hydrochloric acid, PYREX brand Glass dissolves almost imperceptibly for the first few hours and then reaches a point of practical stability. This feature alone would largely account for the long-life records of PYREX Gauge Glasses.

The third important characteristic of PYREX brand Gauge Glasses is their toughness and strength—rarely do they break from mechanical causes in boiler service.

If you do not now enjoy the economy of PYREX brand Gauge Glasses, specify them the next time you order from your dealer.

Corning Standard Gauge Glass

"PYREX" is a registered trade-mark and indicates manufacture by Corning Glass Works, Corning, N. Y.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses

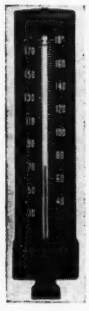
Plastic Electric Drill

THOR ¼-in. capacity Plastic Electric Drill, stated to be the first major portable tool development to conserve aluminum, has been developed by Independent Pneumatic Tool Co. of Chicago.

The new drill, its housings constructed of tough Thorite plastic was developed to conserve aluminum and at the same time answer production demands, with a heavy duty electric drill. The Army has contracted for exclusive production and the drills have been put into use at bases all over the world. It is claimed that it is 14 per cent lighter in weight than older type tools; easier handling, cooler running, and gives greater protection from shock because of the durability of the new plastic.

Pressed Steel Case Glass Thermometer

ENTIRELY NEW THERMOMETER designed to incorporate every new improvement heretofore added to existing glass thermometers, plus many new improvements, is announced by the American Schaeffer & Budenberg Instrument Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn. It was originally designed as a means of conserving the critical copper used in cast bronze cases. It has been made so that it is possible to furnish back, side, and oblique angles without using the ball joint. Scales and tubes are located to produce greatest readability. A new method of making the scale has been developed to produce a more legible and better-looking scale than available before.



The case has been reinforced for stiffness, the screw that holds the cover has been attached so it can never come loose and be lost. The black suede finish showed no corrosion after 100 hours in salt spray. Scale is black with yellow figures, tube is red-reading mercury.

This new thermometer weighs approximately ⅓ less than the present standard glass thermometer of same size. It meets fully Navy specification 18-T-7.

New Bushing Line, 7.5 to 25 kv

NEW LINE of Pinco dry pipe equipment bushings for use on voltages from 7.5 kv up to and including 25 kv has been announced by the Porcelain Insulator Corporation of Lima, New York. For currents up to 400 amp, flanges are of galvanized, electric-furnace, annealed malleable iron. For services above 400 amp they have bronze flanges. Other types are furnished on special request.

Bushings are of standard Pinco high voltage porcelain. Special attention is paid to the relation between porcelain and metal at the cemented areas and to the alignment of flanges and terminals.

CHANGE OF ADDRESS

To avoid missing an issue or paying for forwarding postage be sure to send a change of address to our office. Changes received by the 20th of the month can be made effective for following month's issue.

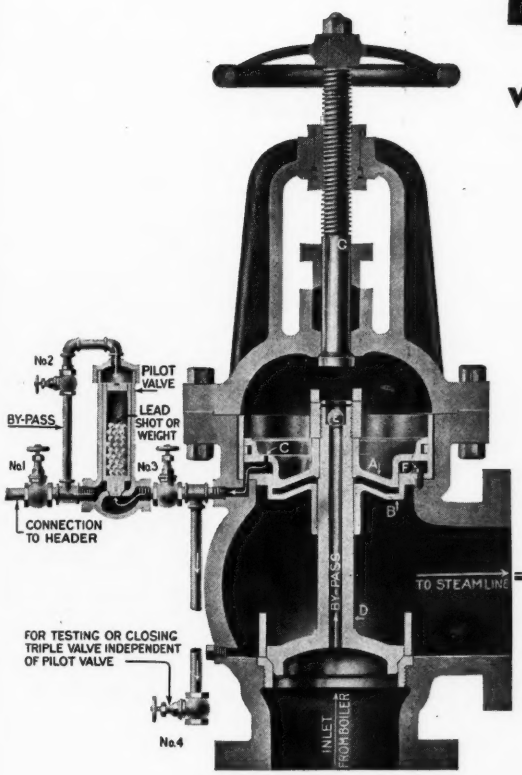
POWER PLANT ENGINEERING

GOLDEN-ANDERSON

SPECIALTY VALVES

For Industry

working under pressure!



● Capacity . . . ability to hold adjusted pressures . . . safe, positive action under strenuous operation—these qualities are inherent in all GOLDEN-ANDERSON Specialty Valves. In service on your water lines and tanks G-A Valves will prove their worth . . . overcome your service troubles and increase the efficiency of your operations. Information on the full line of GOLDEN-ANDERSON Specialty Valves is readily available . . . write, wire or phone today!

GOLDEN-ANDERSON TRIPLE-ACTING NON-RETURN VALVE

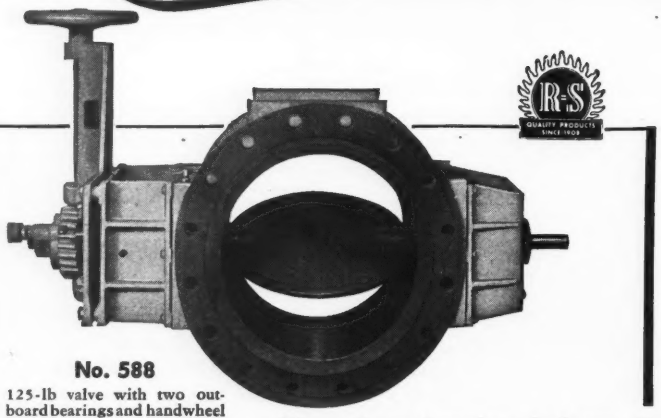
● In the event that a high pressure line breaks . . . if a tube blows in one boiler of a battery, the whole battery will explode through the ruptured point, unless you have the automatic life and property protection of the G-A Triple-Acting Non-Return Valve.

Because it is triple-acting, it automatically cuts in a boiler whenever boiler pressure equals line-header pressure. It isolates a boiler automatically, whenever its pressure, from any cause, is lower than line-header pressure. It prevents steam flow from boiler, if there is a sudden drop of line-header pressure below the boiler pressure. These valves are regularly furnished in Angle, Globe and Elbow patterns; sizes from 2½" to 12" . . . also available in larger sizes as well as in the Cross pattern. The G-A line includes Altitude Valves, Emergency Stop Valves, Steam and Water Pressure Reducing Valves, Check Valves, Float Valves, etc.

GOLDEN-ANDERSON VALVE SPECIALTY CO.

FULTON BLDG. • • • PITTSBURGH, PA.

DOUBLE DUTY
DOUBLE-QUICK ACTION



No. 588
125-lb valve with two outboard bearings and handwheel control.

No. 587
Power operated by air diaphragm motor. Hand wheel for use in case of power failure.

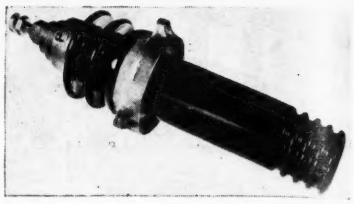
15 to 900 psi
for air, gas, steam, liquids and semi-solids. Substitute metals are available for resistance against heat, abrasion and corrosion.

Throughout American Industry, Butterfly Valves have long been recognized as the ideal type for the control of volume and pressure. With the improved R-S precision machined—wedge type design, these valves are also used with equal effectiveness for the shut-off of any material that flows or is forced through a pipe.

The beveled vane seats at an angle against the valve body and tends to close itself under a pressure drop. Four to six revolutions of the hand wheel completely open or close the valve vane—that's double-quick action. Manually or power operated under pressures up to 900 pounds and from extremely high temperatures to sub-zero refrigeration conditions. R-S Butterfly Valves meet today's need for non-complicated construction, simplified operation and lower over-all costs. Write for detailed specifications.

VALVE DIVISION
R-S PRODUCTS CORPORATION
4535 Germantown Ave., Philadelphia 44, Pa.

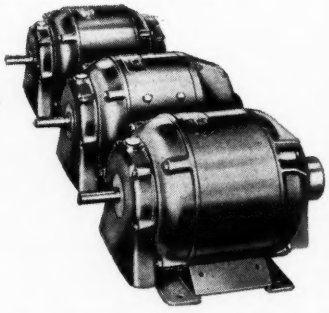
R-S Streamlined BUTTERFLY VALVES



All joints are gasketed and every bushing is tested under substantial pressure for operation under either oil or gas conditions. They are furnished in either draw lead or fixed type terminals as specified.

Uni-Shell Motors

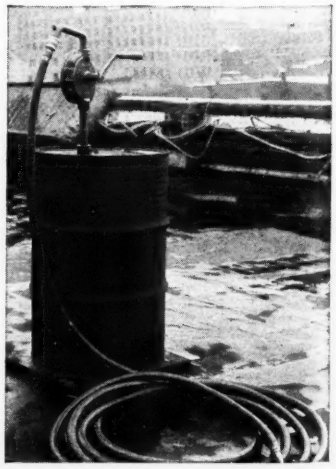
A NEW LINE of Uni-Shell electric motors, built within cylindrical shells of steel, in which all motor types in any one frame size are interchangeable, has been developed by Robbins & Myers, Inc., Springfield, Ohio. The shell dimensions, head fit, bolt circle holes, shaft size and conduit box mountings for any one frame size are identical for all motor types.



These motors are made in the following types and sizes: polyphase induction motor, 1 to 30 hp; capacitor start, single-phase induction motor, 1 to 5 hp; standard dc motor and generator, 1 to 7½ hp or ¾ to 5 kw; and repulsion induction motor, 1 to 5 hp.

Blackmer Auxiliary Fire Pump

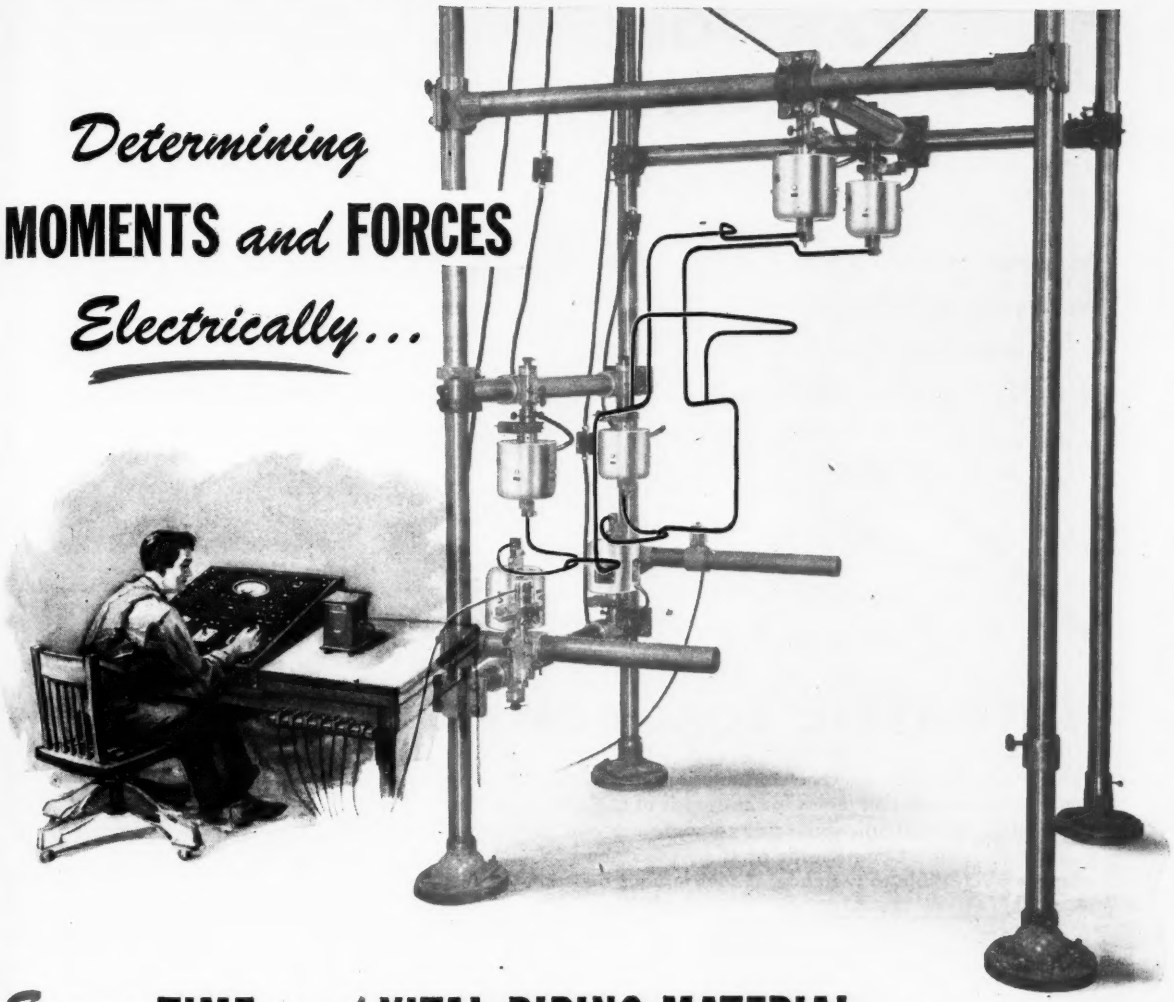
AS THE RESULT of a demand from plant safety men for a hand-operated pump of greater capacity and higher pressure than the so-called "stirrup pump," Blackmer Pump Co., Grand Rapids, Mich., has developed an



Determining

MOMENTS *and* FORCES

Electrically...



Saves **TIME *and* VITAL PIPING MATERIAL**

The most complicated design problems of high temperature piping systems are solved by apparatus perfected and used by The M. W. Kellogg Company.

Through tests conducted on models built to scale, an exact scientific analysis of the end reactions is determined. Stresses are then computed from these reactions. The apparatus used determines the forces and moments electrically, giving faster readings and eliminating the variations present in mechanical weighing due to friction and sticking in the apparatus. Forces are weighed down to one-hundredth of a pound.

When designing complicated piping systems, the use of this scientific method secures exact results, saves time and often substantially reduces the quantity of vital piping material required.

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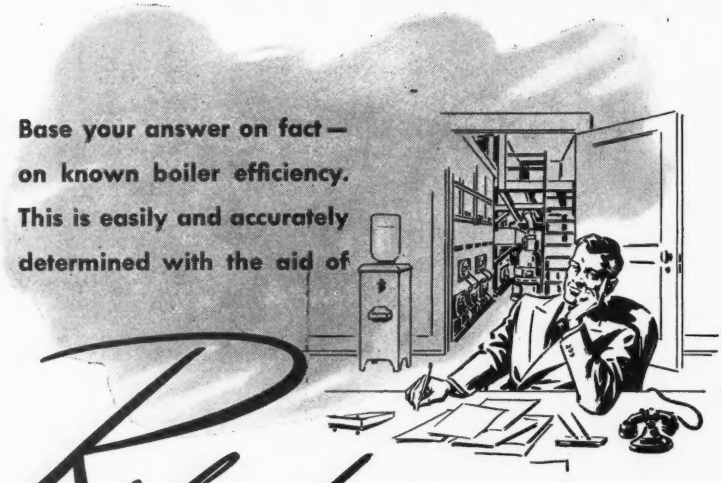
CAN YOU CUT YOUR POWER BILL?



Base your answer on fact—
on known boiler efficiency.
This is easily and accurately
determined with the aid of

Richardson

AUTOMATIC COAL SCALES

Their precise figures on coal consumption enable you to compile dependable evaporation tables for any grade of coal under test. From these tables it's a simple matter to compute the cost per thousand pounds of steam. Comparisons of these costs show beyond doubt whether it's feasible to use cheaper coal in your boilers.

Richardson Automatic Coal Scale of 12 tons per hour capacity, supplied complete with bunker gate fed from overhead bunker and discharging to mechanical stoker.

Known boiler efficiency also tells when a boiler is consuming too much fuel. Savings of 10% on coal bills are common where Richardson Coal Scales are working. Power engineers like their continuous accuracy, the way they weigh and record without attention, and their dust-proof construction. Models can be equipped with elongated conveyors that eliminate extra equipment and save headroom. For details, send for catalog 1143. Contains 46 pages of illustrations and technical data.

RICHARDSON SCALE COMPANY

CLINTON, NEW JERSEY

Atlanta Boston Chicago Minneapolis Montreal New York
Omaha Philadelphia San Francisco Pittsburgh Toronto Wichita

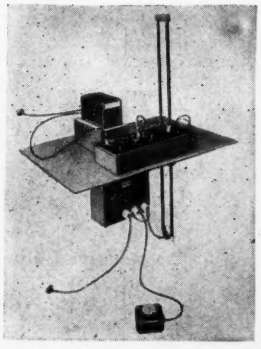
4339

adaptation of the standard barrel-mounted rotary hand pump for use as an auxiliary fire pump. It is intended for use if the main plant water system were bombed or otherwise put out of service and roof-fires started. Drums or barrels of water are set at proper locations on the roof. A pump is installed on each drum, and a length of garden hose, with an adjustable nozzle. The pumps are self-priming, are made in capacities from 7 to 25 gpm, will develop adequate pressure for a 25 to 30 ft stream.

Precision Coil-Turn Counter

AN IMPROVED coil-turn counter for laboratory or factory use in determining with precision the number of turns in wound electric coils has been announced by the Special Products section of the General Electric Co., Schenectady, N. Y. This new counter is more compact in design than the former model and incorporates a magnetizing current control box which simplifies installation. The counter is capable of checking or determining the effective turns of coils from 1 to 11,110 turns, at a rate of from 80 to 100 coils of like specifications per hour.

The operation of the counter is simple. The coil to be tested is placed over the test rod and connected to test clips. The dials on the galvanometer control panel are set to the number of turns the coil should have, and the foot switch is pressed. If the galvanometer dial shows a deflection, the dial readings are increased or decreased until the deflection is zero. The dial reading is then the number of turns. When the probable number of turns in a coil is not known, a trial reading is taken and the dial is adjusted until the reading is zero on the galvanometer.



The reference coils are enclosed in the galvanometer control case while the test rods are mounted on the case. This gives better protection to the reference coils and more compactness.

Use of the magnetizing current control box with the new counter eliminates additional wiring and all that is necessary is to plug in the connecting cord of the box. The magnetizing circuit is designed to operate from a 120-v direct-current supply when used with a resistor furnished as part of the control box, or from a 20-v storage battery when used without a resistor. Accuracy of the counter is one turn in a thousand for coils having air cores at least 5/8 in. in diameter, an outside diameter of 8 in. and less, a coil build-up to 2 5/8 in., and up to 6 in. in height. Accuracy is not as high for coils outside these limits.

ADAP
TYPE
Hand-Fire
Gas-Fired,
Coal-Fired

CAPAC
BUILT-

Internal
by an e
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control
action a
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horsepow

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WING

ADAPTABLE TO ALL TYPES OF BOILERS

Hand-Fired, Stoker-Fired, Oil-Fired, Gas-Fired, Bagasse-Fired, Pulverized Coal-Fired, etc.

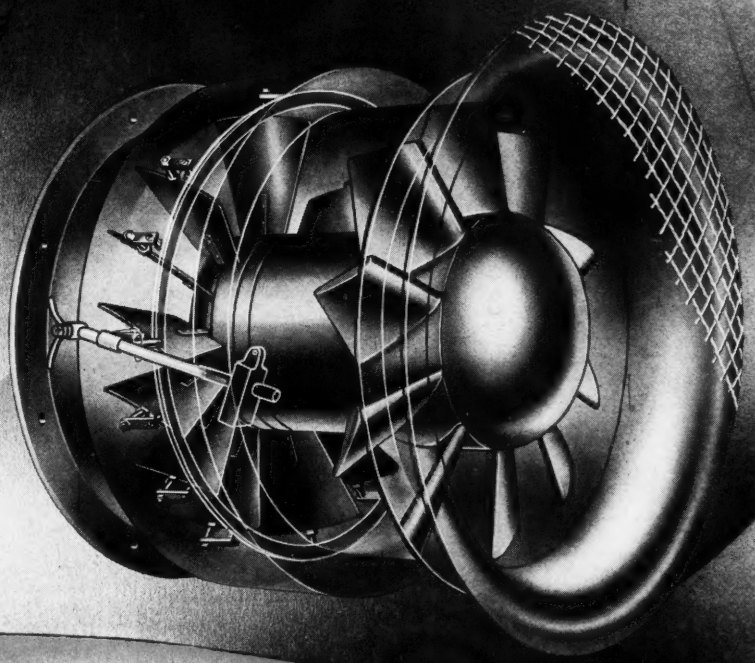
WING SINGLE-STAGE BLOWER

TYPE EMD

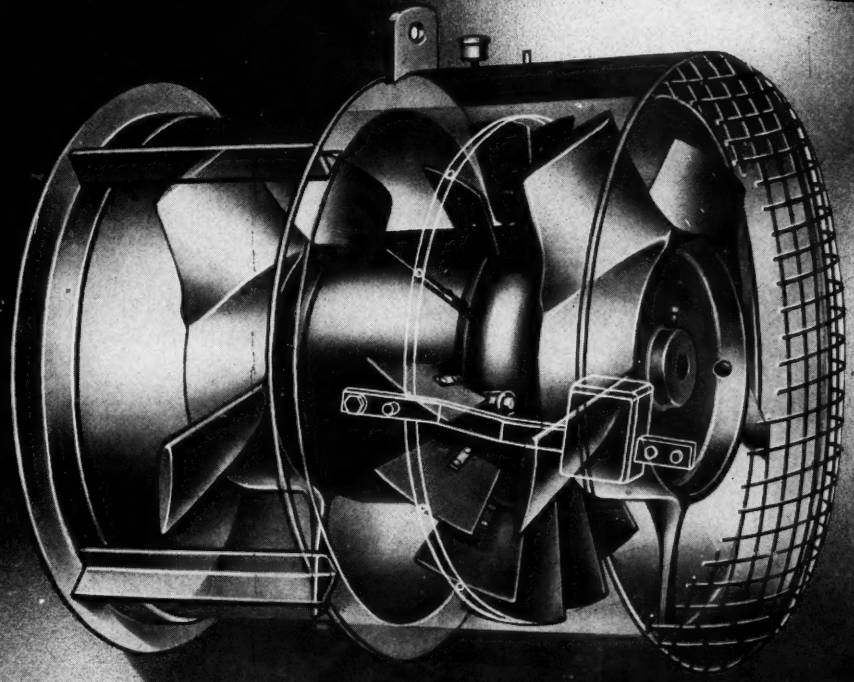
CAPACITY REGULATION BY BUILT-IN VOLUME CONTROL

(Wing Voltrol-Vanes)

Internal radial dampers are actuated by an external balanced lever. This can be adjusted manually or connected to any standard combustion control regulation. It is precise in action and a reduction of volume is accompanied by a reduction of horsepower over a wide range.



WING AXIAL FLOW BLOWERS with VOLTROL-VANES



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WING TWO-STAGE BLOWER

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COMPACTNESS

Economy of Space and Weight

EASE OF CONTROL

QUIET OPERATION

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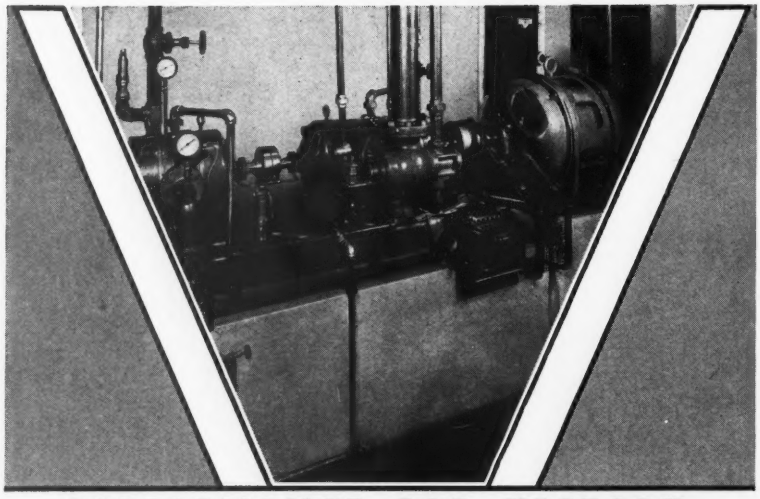


PERFORMANCE FOR VICTORY

AND PEACE-TIME PRODUCTION

Fuller Rotary Compressors are doing their part in a big way to win the victory and, after that, they'll still be on the firing line for peace-time production. They're working day and night in cement and steel plants, foundries, shipyards, alcohol, aircraft, and chemical plants, gas and oil refineries. They're built to take it and performance records prove their worth.

One plant engineer in a war industry writes: "It is now approaching the third year of continuous operation for your two-stage compressor, (1800 C.F.M., 100-lb. pressure), during which time we are glad to report that the service load factor has been in the neighborhood of 99.9 per cent."

Another — "Your two-stage compressor, (100 C.F.M., 90-lb. pressure), has run 23 hours per day almost continuously for four years and has given no trouble." Not a cent was spent for repairs during these four years.

In a foundry — during three years' operation only $3.90 was spent for repairs on a two-stage compressor, (330 C.F.M., 100-lb. pressure).

Performance such as this will help to gain a more speedy victory. And, after that, they'll still give you many years of efficient performance at minimum operating expense with capacities maintained for the life of the machine.

FULLER ROTARY COMPRESSORS

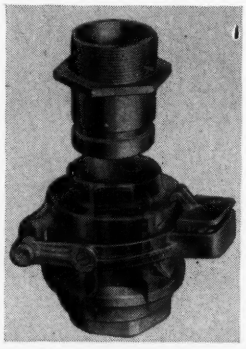
FULLER COMPANY

CATASAUQUA — PENNSYLVANIA

CHICAGO, 3 Marquette Bldg. | WASHINGTON, 5, D.C. Colorado Bldg. | SAN FRANCISCO, 4 Chancery Bldg.

Disconnect Coupling

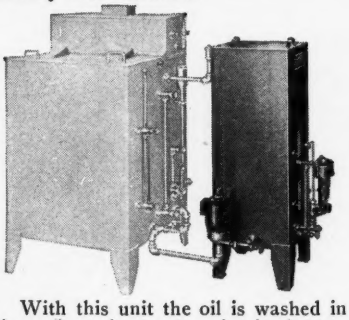
E. B. Wiggins Oil Tool Co., Inc., Los Angeles, Calif., reports that new applications of the Wiggins quick disconnect couplings are constantly being made by industrial engineers and technicians, in the handling of all fluids as well as compressed air and vacuum. Because of instantaneous release much time is saved, enabling men to do liquid-moving jobs many times faster than with the old style method.



Industrial and marine couplings from 2 to 10 in. in size are disengaged by releasing a latch and throwing a lever. Connection is made by placing the two ends of the coupling together and raising the lever. The couplings are all made in accordance with Federal Specifications and the larger sizes are individually tested for pressure and porosity. Sizes ¾ to 2 in. are die cast from Zamak and larger sizes are machined from brass or aluminum.

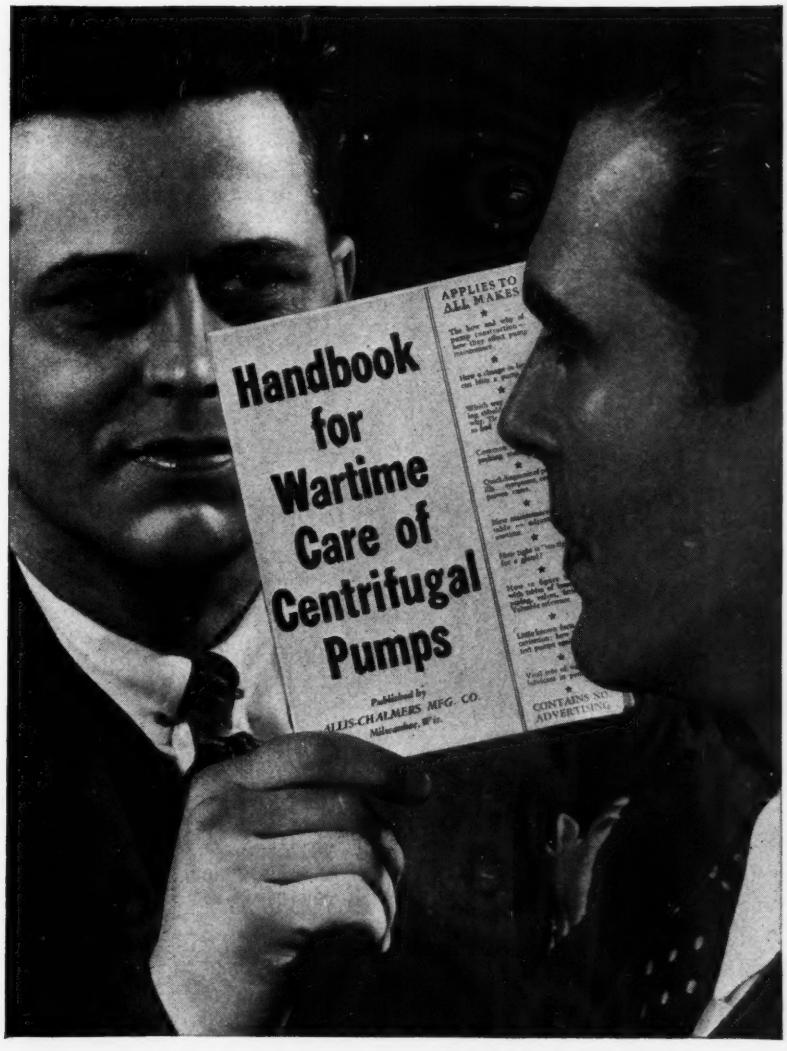
Oil Conditioning Unit

Precipitation, filtration, acid correction and dehydration of lubricating oil in use are accomplished with a new oil conditioning unit developed by S. F. Bowser & Co., Fort Wayne, Ind., and designated as Figure 833, to be used with the company's Type A filtration system, or with receiving or precipitation tanks in oil circulating and filtration systems, or it may be used independently for treating high demulsibility oils by means of water washing combined with dehydration and extremely fine filtration.



With this unit the oil is washed in clean, heated water maintained at a predetermined temperature, where the water soluble products of oxidation are retained by the water both due to their greater affinity for water than for oil. By constantly circulating a portion of the oil from the clean oil compartment of the filter through the unit, the oil can be kept clean and the acid point held to a safe, low factor.

Pump Book Makes News!



HOW TO MAKE EQUIPMENT WORKING ROUND THE CLOCK LAST IS INDUSTRY'S MOST DISCUSSED SUBJECT. MOST DISCUSSED BOOK IS A-C'S NEW PUMP MAINTENANCE GUIDE!

NOW THAT PUMPS are working 2 and 3 times as many hours a week as in peacetime, *they need wartime care* . . . the kind set forth in Allis-Chalmers new "Handbook for Wartime Care of Centrifugal Pumps"!

By building a pump on paper, this new handbook takes a *fresh* look at pump anatomy. Contents include new preventive maintenance tips, a guide to spotting trouble, a new *war* timetable for pump care, valuable tables. Tear out the coupon below and send in now for *your* free copy!

Contains no advertising— applies to all makes — copies mailed free of charge. Use it to make present pumps last. And when you *do* need new pumps, look into the extra efficiency, ruggedness and long life of Allis-Chalmers centrifugal pumps — the famous "Electrifugal" . . . and all types for every purpose.

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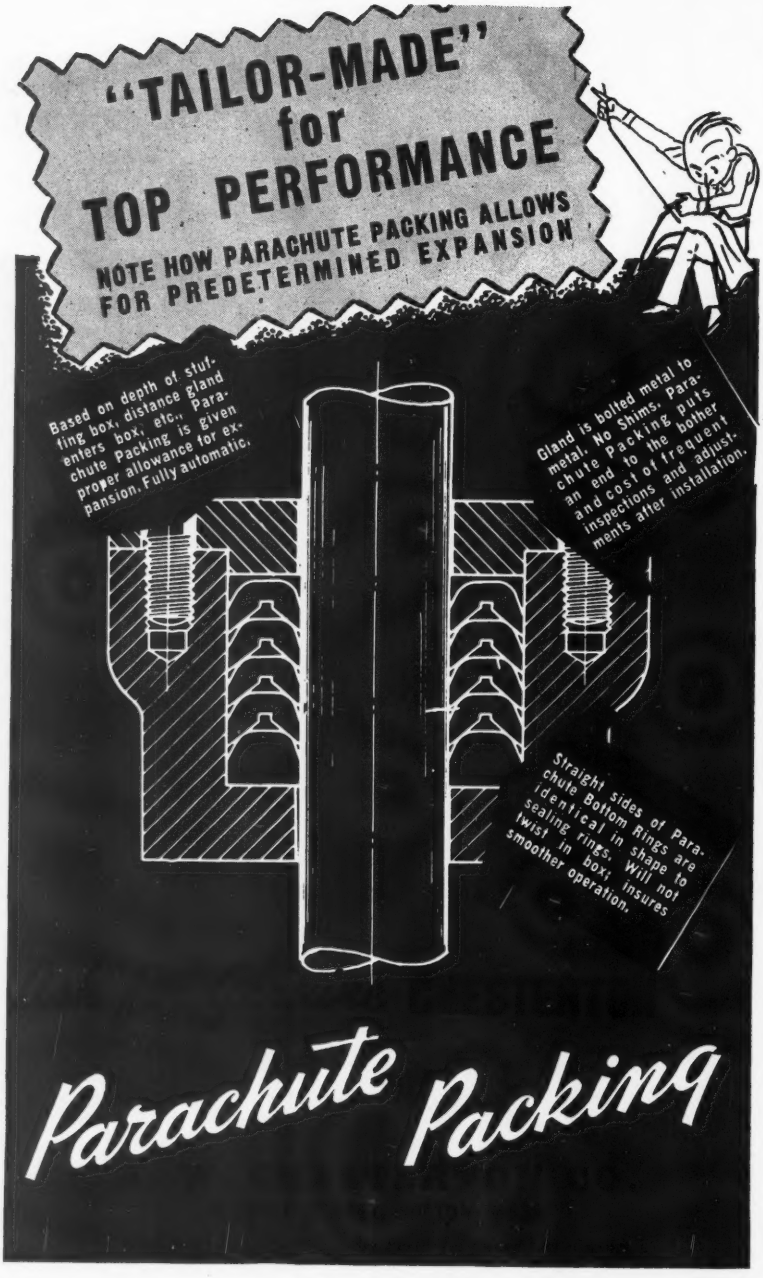
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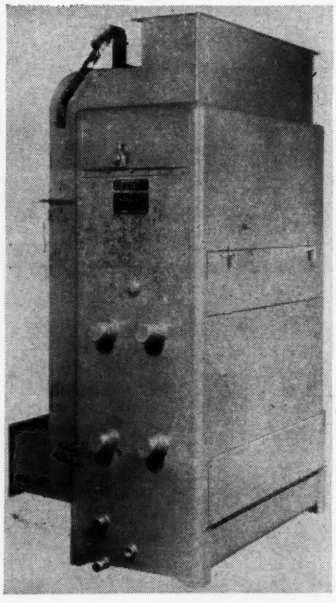
NOTE HOW PARACHUTE PACKING ALLOWS FOR PREDETERMINED EXPANSION
Based on depth of stuffing box, distance gland enters box, etc., Parachute Packing is given proper allowance for expansion. Fully automatic.
Gland is bolted metal to metal. No Shims. Parachute Packing puts an end to the bother and cost of frequent inspections and adjustments after installation.
Straight sides of Parachute Bottom Rings are identical in shape to sealing rings. Will not twist in box; insures smoother operation.
Parachute Packing

Heat Exchanger Control

NIAGARA BLOWER Co., New York 17, N. Y., has announced a new automatic control feature to be used in connection with the Niagara Aero Heat Exchanger. This is accomplished by using either a steam coil or injector or an electric heating unit to heat the spray water.

The result is control of liquid temperatures within prescribed limits, alternately cooling or heating as required. The heating device is put into operation by thermostatc control at the desired point, preventing the liquid from becoming too cold for the process in which it is used, or from becoming viscous with retarded flow and loss of capacity, or from congealing or freezing. This also makes it possible for the heat exchanger to be successfully installed out of doors, or to use fresh, out-of-door air to increase its evaporative cooling capacity and avoid damage from handling air containing corrosive substances.



Heat exchangers with these features are used to control temperatures in industrial, chemical process and electrical equipment by controlling jacket water temperatures, also quenching baths in the heat treating of metals, cutting oils and lubricants in metal working, machining and wire drawing, controlling temperatures of chemical process liquids in many fields, and engine jacket water. It is also applied to air and gas compressors.

V-Belt Sheaves

AMONG THE OUTSTANDING features of the new Pyott QD "Quick Detachable" sheaves, manufactured by Pyott Foundry & Machine Co., Chicago, Ill., and used with multiple V-belt drives, are the ease, speed and absolute safety with which the sheave is attached to or removed from the shaft. A socket wrench is the only tool needed for either job.

The accompanying illustration shows the steps involved in attaching sheave to shaft. First step is slipping the tapered, split Pyott hub onto the

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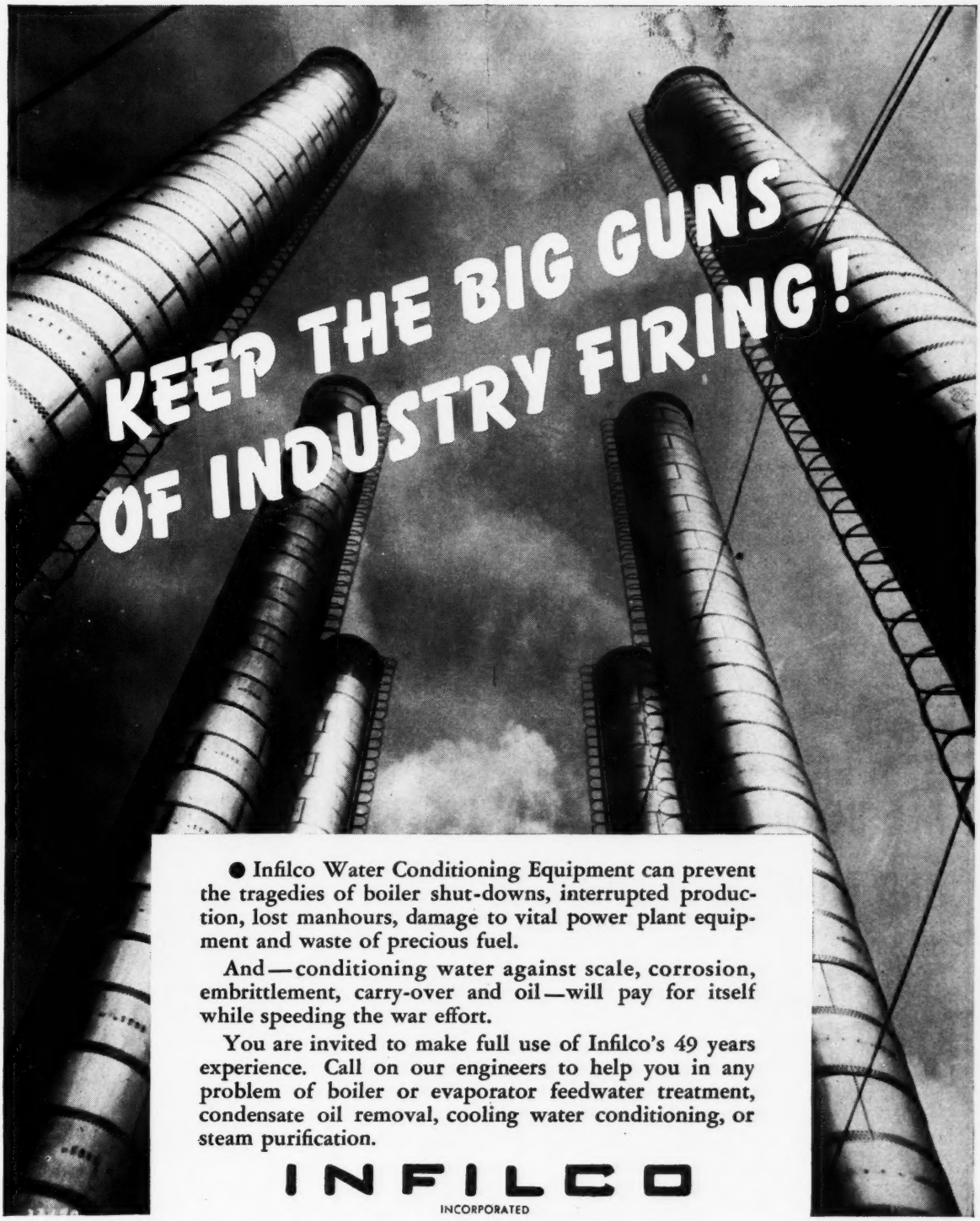
When writing advertisers for catalogs, descriptive bulletins or prices, please remember to say, "I saw your message in POWER PLANT ENGINEERING." Thus you'll do a good turn for the advertiser and for this publication. . . .



● Infilco Water Conditioning Equipment can prevent the tragedies of boiler shut-downs, interrupted production, lost manhours, damage to vital power plant equipment and waste of precious fuel.

And—conditioning water against scale, corrosion, embrittlement, carry-over and oil—will pay for itself while speeding the war effort.

You are invited to make full use of Infilco's 49 years experience. Call on our engineers to help you in any problem of boiler or evaporator feedwater treatment, condensate oil removal, cooling water conditioning, or steam purification.

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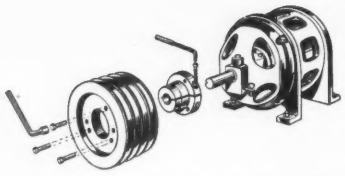
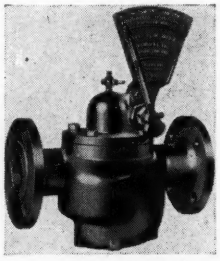


shaft in line with the keyway. Then the headless cap screw shown is tightened down with an inserted key, clamping the hub firmly on the shaft and producing a virtual press fit, even on undersized or oversized shafts. Next step is attachment of the sheave on the tapered hub. Actual tightening of the sheave on the hub is accomplished by inserting the pull-up bolts shown in the illustration and tightening them evenly with a socket wrench. These bolts protrude through the sheave and engage with threaded holes in the hub to form an immovable union. Removal of the Pyott QD sheave from the hub is equally simple. Pyott QD sheaves are available in standardized sizes.

Improvements in Henszey Flow Indicator

SEVERAL IMPROVEMENTS in the Henszey flow indicator for indicating the rate of flow of liquids have recently been announced by the Henszey Company of Watertown, Wisconsin.

The most obvious of these is the elimination of the outside spring. This was used in former indicators to bring the pointer back to zero when the flow of liquid stopped. The indicator is now designed to provide a positive action between the plunger and pointer and this has made the outside spring superfluous, it is stated. This positive action, it is claimed, eliminates any inaccuracy that might have resulted if an old spring became stretched or damaged.

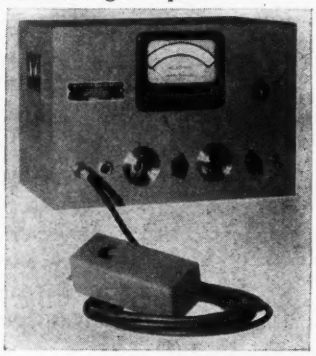


Another improvement is the elimination of the plunger seal, for it is stated that in the new simplified mechanism there is nothing that can be harmed by dirt in the liquid being measured. The plunger seal was formerly used to keep any such dirt from coming in contact with the plunger arm.

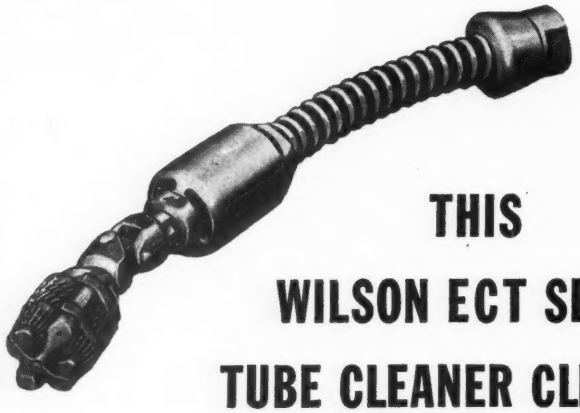
Several other working parts have been eliminated, it is announced, and some parts have been strengthened to insure long life and efficient operation.

Electronic Meter

A NEW ELECTRONIC time-interval meter for accurately measuring extremely short intervals, as low as 100 microseconds, has been announced by the Special Products section of General Electric Co., Schenectady, N. Y. The meter is specifically designed for measuring the time interval between two events which can be converted into electrical impulses, such as the elapsed time between the closing of two controls, between two impulses to a phototube, and between an electrical impulse and a light impulse.



The meter consists of two units, an electronic panel and a phototube with preamplifier stage. It has eight ranges, selected by means of a tap switch so that any time interval of a length between 0.001 and 3 sec can be measured. A standard indicating instrument calibrated in milliseconds gives a direct reading of the time interval measured. The meter operates from a 115-v, 60 cycle lighting circuit and is stabilized so that normal line-voltage variations do not affect its accuracy, which is 2 per cent of full scale value, or one scale division. The



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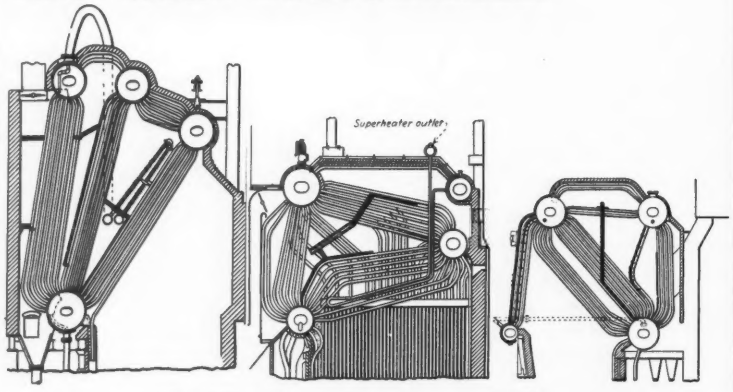
WILSON ECT SERIES
TUBE CLEANER CLEANS
ALL BENT TUBES BETTER, FASTER
AND MORE ECONOMICALLY



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THE WILSON BUILDING
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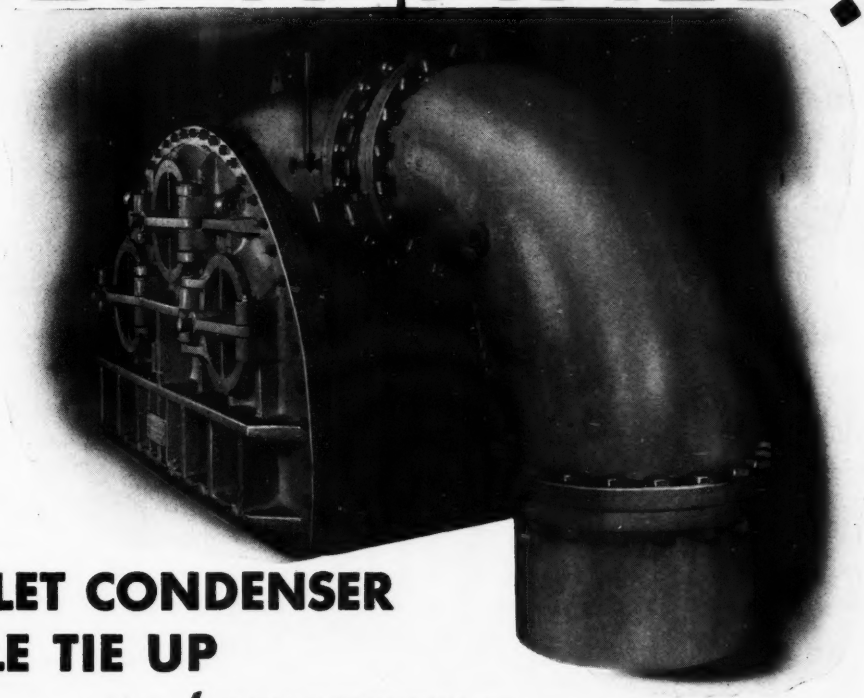


DON'T LET CONDENSER TROUBLE TIE UP *vital* EQUIPMENT

Why wait for an actual failure that might force a shutdown at a time when you can least afford production stoppage? By planning overhaul *now*, you can *schedule* your shutdown — off peak.

Those who have had a Conseco overhaul . . . and there have been many . . . know how fast and thoroughly we work. Here's why:

- ***Our men are Specialists*** — for 15 years we have been servicing condensers and heat exchangers for utilities and for industrial plants all over the country. We know the fastest practical way to tackle your job.
- ***We have our own technique and tools*** — developed for the express purpose of servicing condensers, to give you a better, faster job.
- ***It is a nation-wide 24 hour service*** — men, facilities, and often complete replacement materials are immediately available.

A wire or phone call will start your job rolling to fit *your* schedule.

Condenser Service
AND ENGINEERING CO., INC.

83 RIVER STREET, HOBOKEN, NEW JERSEY

★

NEW JERSEY TELEPHONE—HOBOKEN 3-4425

NEW YORK TELEPHONE—RECTOR 2-9360 **AFTER 6 P. M. AND SUNDAYS—HOBOKEN 3-4428**

9—CS—1

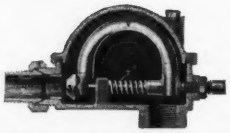
HAINES MEDIUM PRESSURE STEAM TRAPS

Speed Outputs — Save On Upkeep

Haines Steam Traps are widely used in Textile Dryers, Steam Presses, Hospital Equipment, Steam Kitchens, Air Conditioning Systems, etc., to provide larger outputs with same fuel, and save on plant upkeep.

As pictured at right, the Haines operating unit consists of a spring tempered tube which contains a volatile fluid hermetically sealed. So sensitive that a temperature change of one degree will operate valve.

Every Haines Trap can be examined under pressure at any time. All parts are interchangeable. And the trap is ready for business the instant steam is turned into the line. Write for descriptive folder.



Haines Model 08 shown, handles pressures from 0 to 60 lb.; capacities from 500 to 3800 sq. ft. E.D.R.

WILLIAM S. HAINES & CO., 12th & Buttonwood Sts., PHILADELPHIA, PA.

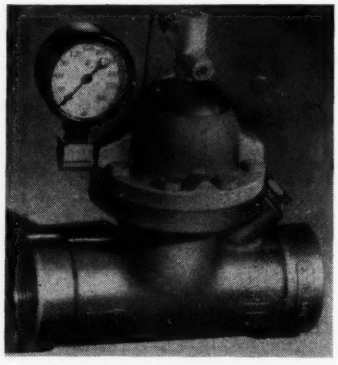
Makers also of Radiator, Float and Thermostatic Traps

meter will continue to indicate the time interval after measuring, with a drift of less than one division per minute. When another reading is required, a push button immediately clears the dial.

The normal input signals consist of changes of light intensity falling on the phototube or the making of external electrical contacts. Light values as low as 1/100 1 or an intensity of approximately 1.4 ft-c can be used on the phototube and result in satisfactory performance.

New Automatic Stop Valve

THE NEW GROVE Automatic Stop Valve recently announced by Grove Regulator Co., 65th and Green St., Oakland 8, Calif., is designed for use on air or gas pressure lines, where there is any possible danger of fractures or leakage resulting in pressure loss or damage. It automatically shuts off the flow when the pressure falls to a preset point. It must then be manually reset before the flow is permitted to be resumed.



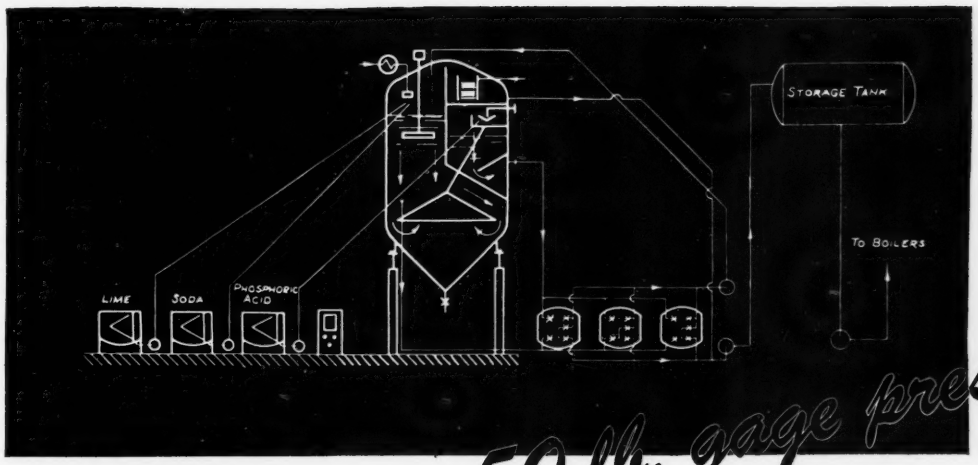
A few of the many applications on which this valve is employed include: Lines carrying gas at high pressures, where a large volume of escaping gas might create a fire or explosion hazard in addition to losing required system pressure; gas lines carrying fuel to boilers, ovens, furnaces, etc., where explosions could result from momentary interruption of delivery, followed by the uncontrolled return of fluid supply.

It can be operated on rate of flow differential pressure or on direct static line pressure. In its extremely wide rangeability, a 300 lb valve may be set to operate at any pressure from 5 to 300 lb. The stop point is established by merely presetting the desired shut-off pressure in the dome.

Load-Center Unit Substation

LOAD-CENTER unit substations for semi-hazardous locations in oil refineries, chemical plants, and other plants having similar conditions, has been announced by the General Electric Co., Schenectady, N. Y. Available in standard ratings from 100 to 1000 kva at 480 v and 100 to 500 kva at 208/120Y or 240 v, these unit substations can be used indoors or outdoors for power and lighting service of 600 v and below. Primary voltages from 2.4 to 15 kv can be handled.

The new line incorporates a liquid-filled primary disconnecting switch,



Above is shown the arrangement of Cochrane Hot Process Softener for high pressure, high temperature system.

50 lb. gage pressure

298° F. temperature

COCHRANE HOT PROCESS SOFTENER OPERATING AT HIGH PRESSURE AND HIGH TEMPERATURE IMPROVES PERFORMANCE AND SAVES ON CHEMICALS

THE effectiveness of the hot process softener at high pressures and high temperatures is demonstrated in a recent Cochrane installation.

Whereas most hot process softeners operate at low pressures and seldom over 15 to 20 lb. gage, this softener is operating at 50 lb. gage, with an operating temperature of 298° F.

The chemicals used are lime and soda ash and phosphoric acid.

The installation has a softening capacity of 28,000 g p h of raw water and a capacity to heat and deaerate condensate at a rate of 16,000 g p h.

Softening is carried out in 2 stages. In the first stage the water is treated with lime and soda ash. Then it is decanted to a second compartment where it is deaerated and then treated with phosphoric acid to reduce the hardness and alkalinity remaining after the lime-soda ash process.

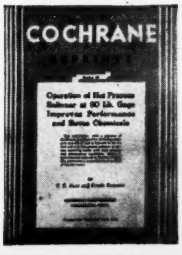
The final effluent is filtered, combined with the condensate and used as boiler feed without further treatment.

This has resulted in a high degree of hardness reduction and in economy of chemicals. Further details of this installation are incorporated in Cochrane Reprint No. 25. Write for a copy.

COCHRANE CORPORATION
3123 N. 17th St., Philadelphia 32, Pa.

AVAILABLE FOR REFERENCE

COCHRANE REPRINT NO. 25

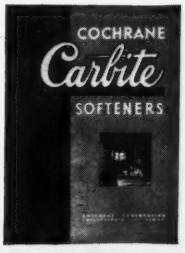


"OPERATION OF HOT PROCESS SOFTENER AT 50 LB. GAGE"

By Joos and Kemmer

A reprint of this story describing in detail the above installation. If interested, this reprint should be of considerable help in solving your own water conditioning problems. Write for a copy Use the coupon →

COCHRANE PUBLICATION NO. 4021



COCHRANE CARBITE (CARBONACEOUS ZEOLITE) SOFTENERS

A 16 page publication describing in considerable detail the Cochrane Carbonaceous Zeolite Softening Equipment, with typical analyses, diagrams and photos of installations. A copy will be mailed on request. →

Cochrane Corporation
3123 N. 17th Street
Philadelphia 32, Pa.

Check Please send me a copy of

☐ Cochrane Reprint No. 25
☐ Cochrane Publication No. 4021

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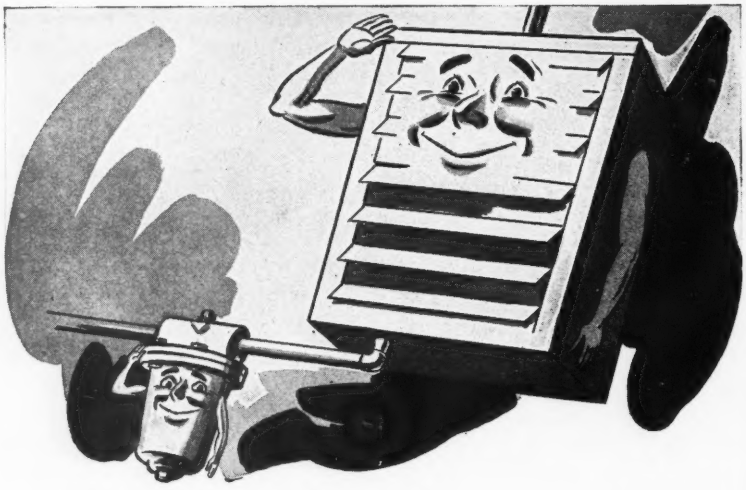
City ---------- State ----------

COCHRANE

HOT PROCESS SOFTENERS · DEAERATORS · BLOW-OFF SYSTEMS · FLOW METERS · SPECIALTIES



"NO ABSENTEEISM for this couple"

Plants that trapped their unit heaters with Anderson Super-Silvertop Steam Traps find that today there is no absenteeism for their heaters or their traps —both are on the job every day. Super-Silvertop keeps the unit heater bone dry and free of air, assuring a maximum heat output. Unit heaters delivering 100% are saving on fuel, which in these times is highly important. Many tests have proved that heat output of unit heaters can be increased 25% by replacing inefficient traps with Super-Silvertop. Write today for a copy of the book entitled, "How To Choose a Steam Trap," giving complete information on trapping unit heaters with Anderson Super-Silvertops.

THE V. D. ANDERSON COMPANY
1939 WEST 96th STREET • CLEVELAND, OHIO

Get Old Valves Back On Their Feet Again

—at less than half of the new valve cost

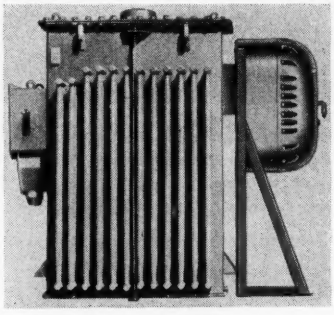
FOR VICTORY'S SAKE reclaim all your Iron, Steel or Brass valves. Every old valve put back in service means that another new one is available for vital war industry—to keep production lines flowing.

Send us those leaky old gate and globe valves you had planned to discard. Our experienced "Valve Doctors" will repair worn seats, discs and other parts. Our charges never exceed 50% of the original valve price; and they usually run around 35%. We pay shipping costs both ways on valves that can't be fixed.

For Victory, Salvage Old Valves — Send Them To
THE COMBUSTION EQUIPMENT & INSULATION CO.
Factory at Greenlawn and Erie R. R. Tracks, Lima, Ohio

standard Pyranol or oil-filled transformer section, and a low-voltage section with a 600-v, easily removable air circuit breaker. The units are completely metal-enclosed, co-ordinated, factory-built substations. All arcing parts are either liquid immersed or in enclosures of Class I, Group D, construction.

Four 2½ per cent taps (two above and two below normal-rated high voltage, and for rated kva) are provided in the high-voltage winding of the transformer. An externally operated, manual tap changer is furnished for operation only when the transformer is de-energized.

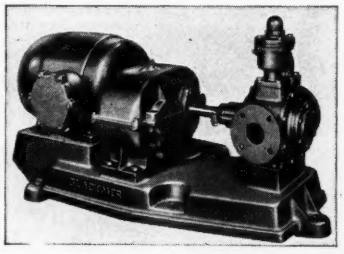


Mounted integral with the transformer section is the incoming switch which is equipped for breaking transformer magnetizing current. A key-type interlock works in conjunction with a similar lock on the low-voltage breaker to prevent the switch from being operated when load is on the transformer.

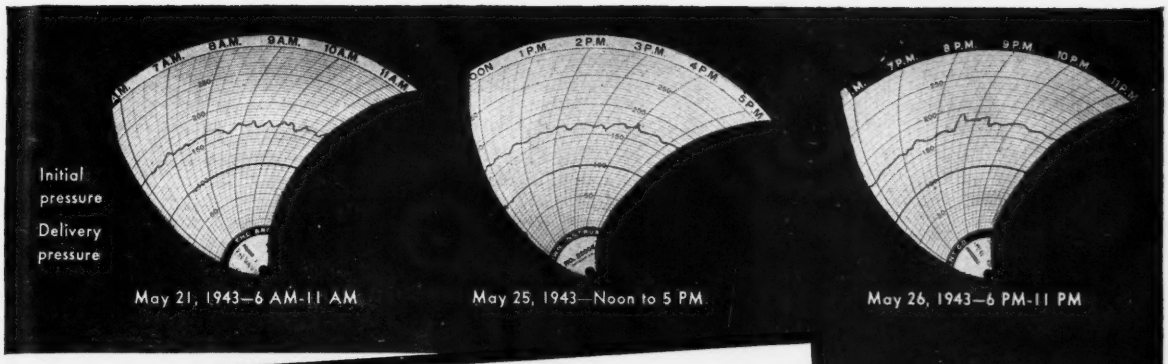
The low-voltage section is furnished with either a manually or an electrically operated main secondary air circuit breaker with time-overcurrent protection and instantaneous short-circuit trip. The circuit breaker is mounted in a metal enclosure.

Pumps With Anti-Friction Bearings

To ITS LINE of standard units, Blackmer Pump Co., Grand Rapids, Mich., has added a new series of rotary pumps with anti-friction bearings. Capacities range from 10 to 750 gpm, at pressures up to 150 psi. These new units are really a by-product of development work which has been carried on by Blackmer Engineers, over the past two years, for the Navy and Maritime Commission.

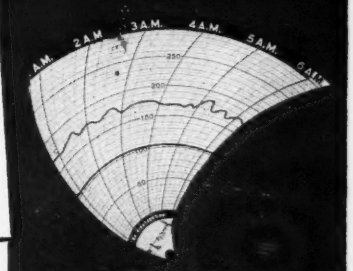


The anti-friction bearing design has the advantage of reducing power requirements and permitting higher operating pressures. As the bearings are in contact with the liquid being pumped, these new units are recom-



"REQUIRED WORKING PRESSURE"

ROUND-THE-CLOCK DAY IN...DAY OUT

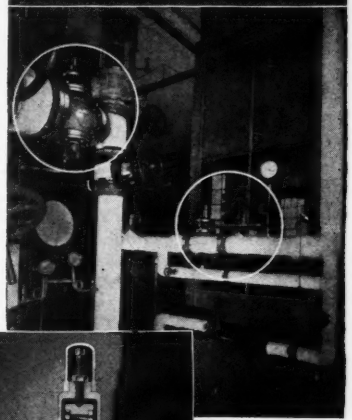


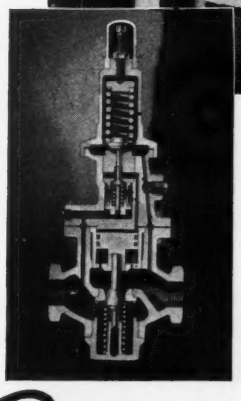
No . . . these charts are not doctored, they are shown exactly as recorded *after* the Foster Type 37-G2 Pressure Reducing Regulator was installed. In fact — *16 years after*. For 24 hours a day, every day during this time, it has delivered steam as required for intermittent processing at the working pressure recommended for the equipment . . . accurately and without maintenance other than periodic routine grinding of pilot valve "whether it needed it or not."

Sorry, we can't give you the whole story, because we don't know the *beginning* — we have no *charts* to show the irregularity of delivery before the Foster Valve was installed. But we *do* know that the foreman in charge of processing was always complaining, "How the *?!!? can you expect me to keep quality up and costs down with pressure wandering all over the lot?" — or words to that effect.

Besides, we don't yet know the *ending*. As far as we can see, there is no reason why this valve should not go on giving accurate, trouble-free regulation for many more years.

Our engineering recommendation was followed as to size and type for this service, and the valve was properly installed. And, incidentally, selection of proper size and type, and planned installation are of paramount importance in assuring satisfactory valve performance. Foster Valves consistently deliver and hold the pressure you require . . . and our engineers will be glad to see that you get the *right* valve for your specific needs, and to make recommendations for its installation. Consult us without obligation.





Typical installation of a Foster Type 37-G2 Pressure Regulator. Catalog 70 shows many other installation suggestions and illustrations, including proper control connections and by-pass arrangements.

Complete, illustrated handbook on Foster Type 37-G2 and other Reducing Valves, Temperature Regulators, Pump Governors and Sirens—with eight pages of useful engineering data—will be sent if the request is made on company letterhead. Simply ask for Catalog 70.

Foster Type 37-G2 auxiliary or pilot operated valves for steam are built with a variety of spring ranges and of alloys suitable for the pressure and temperature—initial pressures up to 1500 pounds—delivery pressures up to 1200 pounds—total temperatures up to 900° F.

FOSTER ENGINEERING Company

PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS... PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

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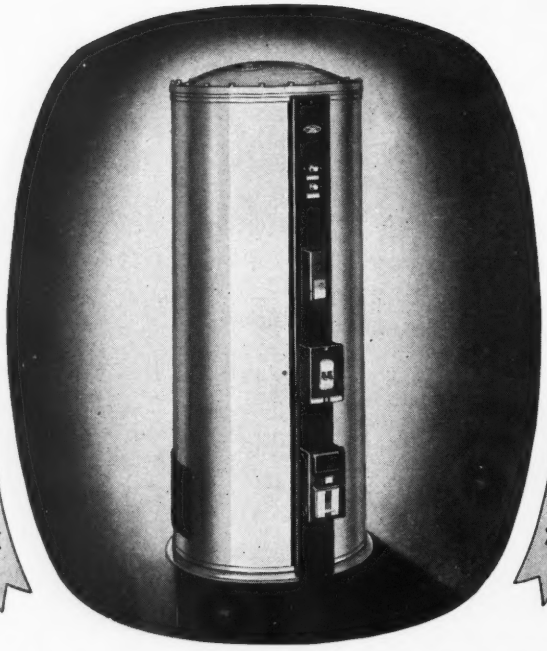

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● More than 20 years of research and manufacturing experience are built into a Honan-Crane "Continuous" Oil Purifier.

Check up with the Operators and Engineers who really "know" and you will find that the Honan-Crane "Continuous" Oil Purifier has an extremely high rating for Oil Purification Efficiency. Honan-Crane Oil Purifiers are:

1. **Direct Connected**—Oil is purified while in service.
2. **Continuous in Operation**—Contamination is removed as fast as it is liberated by the operating equipment.
3. **Removes All Types of Contamination**—Acids, lacquers, sludge as well as abrasives and solid particles.

The performance of Honan-Crane "Continuous" Oil Purifiers is fully guaranteed.

Write for Bulletins on both Diesel Lube and Fuel Oils.

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RESIDENT ENGINEERS IN PRINCIPAL CITIES

Cuts your gasket costs in half

The most remarkable tool ever invented

Write for booklet

THE ALLPAX GASKET CUTTER

Manufactured by
THE ALLPAX COMPANY, INC.
Distributors everywhere *Mamaroneck, N. Y.*

mended only for handling viscous, or non-viscous liquids having lubricating properties, such as oils, molasses, syrups, etc.

Electrode Holder

AN AIR COOLED ELECTRODE HOLDER for use on heavy metallic arc welding jobs around power plants is announced by Jackson Products, Detroit, Mich. Where rods as heavy as ½ inch are used, the intense heat frequently causes discomfort to the welder, thus reducing his efficiency. This insulated heavy duty holder is cooled by air at from three to four pounds pressure, traveling the entire length of the lower tong. It is introduced by connecting the air inlet tube to the plant air line.

The holder is made of special high conductivity copper alloy, with deep-slotted jaws that grip rod tightly and hold it at correct angle. A dependable solder cable connection is provided.

OBITUARIES

J. W. Upp

JOHN WINTERS UPP, 75, former manager of the General Electric Company's Switchgear Division, died at Ardmore, Pa., on August 4 of a heart attack.

Born in Sandusky, Ohio, in 1868, Mr. Upp was graduated in 1889 from Cornell University where he studied electrical engineering. He joined General Electric in 1901 as a draftsman and soon became head of the Drafting Department. In 1907 he was appointed manager of the Switchgear Division, with headquarters in Schenectady. His control extended over switchgear manufacturing divisisons at Schenectady, Baltimore and Philadelphia. Later, he went from Schenectady to Philadelphia, where he centralized the Switchgear Division in a plant in Philadelphia, the planning and equipment of which he supervised. His connections with the Switchgear Division continued until his retirement in 1933.

Mr. Upp was largely responsible for the introduction and use of metal-enclosed switchgear in this country, at first in the form of removable enclosed truck panels and later as metalclad switchgear.

Under his direction were developed and built many of the first large capacity oil circuit breakers, and his ideas influenced switchgear developments for over a quarter of a century. He had made a thorough study of design and manufacturing methods at home and abroad, and was actively concerned with standardization of electrical equipment.

Until his retirement Mr. Upp was a member of the National Association of Manufacturers and the American Institute of Electrical Engineers. In Philadelphia he was a member of the Union League and the Merion Golf Club.

George H. Gibson

GEORGE HERBERT GIBSON, known widely in the engineering field as an inventor and writer, died on July 28 at his home in Montclair, N. J., following a heart attack.

Mr. Gibson was born in Wayne County, Mich., in 1876, graduated from the University of Michigan in 1899 and was employed by Westinghouse Electric

HERE'S ONE ROD PACKING THAT WON'T WEAR OUT IN A HURRY...
JM
• With virtually the entire production of J-M Packings and Gaskets needed for war, delivery on other than high-priority orders may be slower than in normal times. However, through increased capacity and round-the-clock production, every step is being taken to assure the fastest delivery possible under the present emergency.

J-M KEARSARGE LASTS LONGER . . . CUTS RE-PACKING COSTS

For continued efficient service against high-pressure steam, you can't beat this rugged rod and plunger packing.

Its unique folded construction provides natural resiliency and forms a reservoir for the preserving lubricant, keeping the packing pliable in service.

Additional resiliency is provided by a rubber expansion back in the center block. And resistance to wear is assured by a double wrapping of asbestos cloth.

You can use Kearsarge Rod Packing, together with other packings and gaskets in the complete Johns-Manville line, to minimize equipment shutdowns . . . save much of the expense and loss of production caused by too-frequent re-packing.

For details, ask for the J-M Packing Catalog, Johns-Manville, 22 East 40th Street, New York 16, New York.

JM PRODUCT

Johns-Manville PACKINGS & GASKETS

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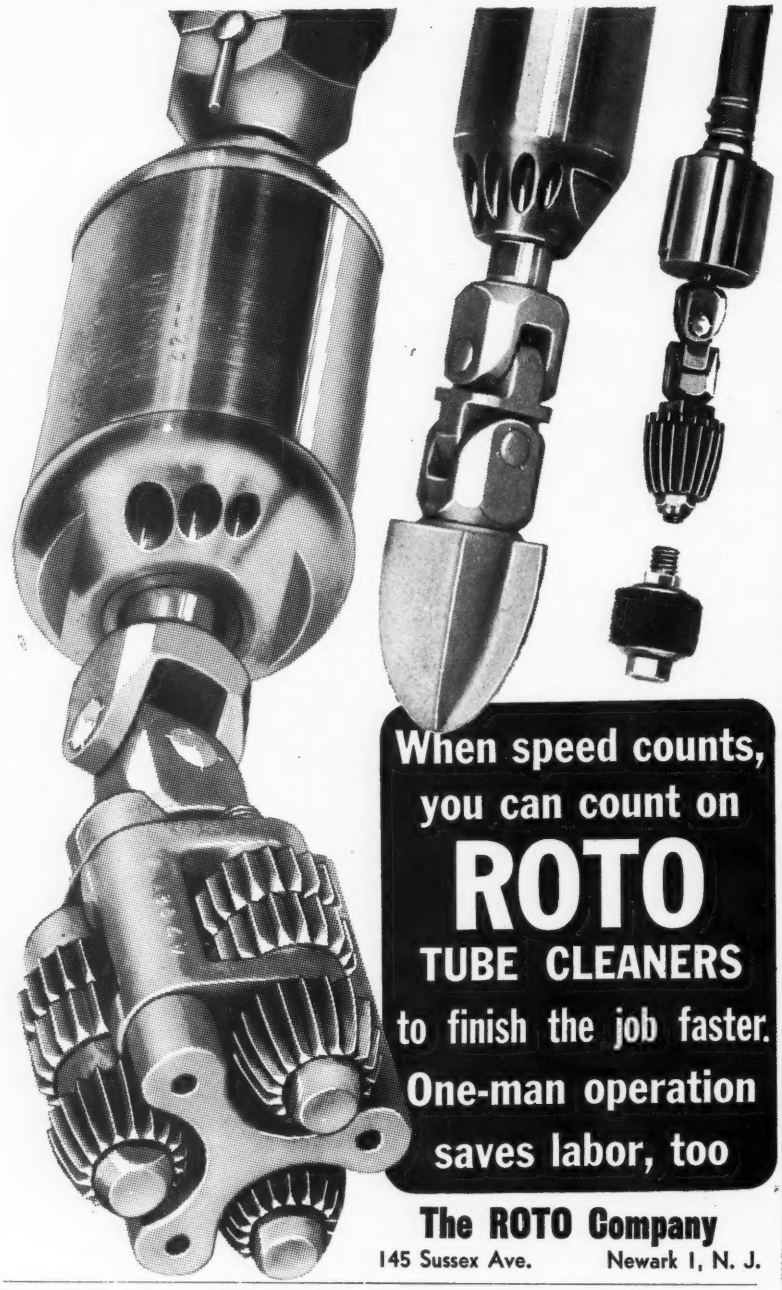


OFFICIAL WAR MESSAGE NO. 4

Hundred Horsepower Hands!

All women have them today! They are no longer "the weaker sex" when a flick of the finger controls a street-car, delivery truck, elevator, tractor, packaging machine . . . all the countless automatic miracles that sustain our civilian life.

In many areas, women are *urgently* needed to fill men's shoes in necessary civilian jobs. Jobs of *every* kind . . . in stores, offices, restaurants, utilities, laundries, community services.

Check your local Help Wanted ads for specific needs in your area. Then get advice from the local United States Employment Service.

& Mfg. Co. With this company, he began specializing in editorial writing and publicity work. Subsequently he became associated with B. F. Sturtevant Co., International Steam Pump Co., and in recent years was a partner in the George H. Gibson Co. Among his inventions are listed: Hispeed fan, BSCO primary battery, "Cochrane" chemical proportioner, "Cochrane" V-notch meter, "Cochrane" non-silite filter, "Cochrane" deaerator, Leeds & Northrup and sublicensed combustion controls. He has been consulting engineer for Cochrane Corp., advertising director for De Laval Steam Turbine Co., and has written many technical articles for the press and presentation before engineering societies. One of his widely used books is entitled "Finding and Stopping Waste in Modern Boiler Roms."

MANUFACTURERS' PERSONALS

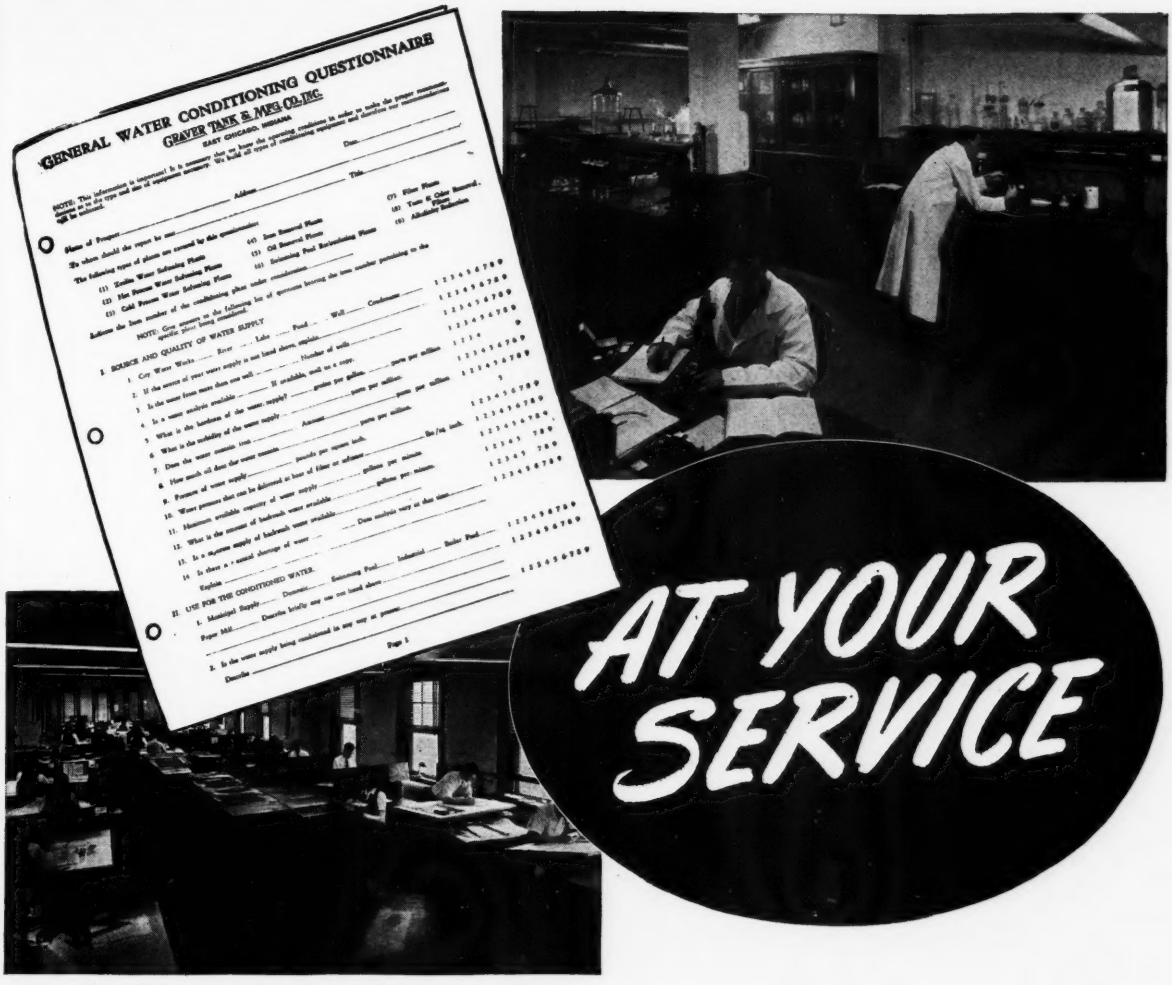
E. W. Scarritt has been appointed sales manager of Elgin Softener Co., Elgin, Ill. Mr. Scarritt is a recognized chemical engineering authority and has advanced many notable contributions to the science of water treatment and purification. He has been with the corporation since 1927.

Harold D. Kelsey has been appointed assistant to the manager in charge of engineering of the Fort Wayne Works of the General Electric Co. to succeed the late R. H. Chadwick, according to an announcement by M. E. Lord, works manager. Mr. Kelsey has been with General Electric since 1920 serving in various capacities and in 1941 became engineer in charge of the engineering department of the Fort Wayne Works, holding that position until his present appointment.

Rogers Diesel and Aircraft Corp. has announced the appointment of Carl Hofmeister as general manager of the Hill Diesel Engine Co., Lansing, Mich., division of the organization. Mr. Hofmeister, recently controller of the Cummins Engine Co. and employed by that organization for the past eleven years, has also been associated with the Curtiss Wright Co. at St. Louis and the Allison Engine Co., Prest-O-Lite and Stutz Company in Indianapolis.

Kenneth F. Cramer has been appointed district manager of the New York office of The Baldwin Locomotive Works, as announced by Ralph Kelly, president of the company. Mr. Cramer succeeds Joseph F. Hoerner, who has been assigned to special duties in Washington, D. C. Mr. Cramer has been with the company since October 1940, starting as Kansas City district manager for the Diesel division. Later he was transferred to the Chicago office, specializing in Diesel locomotive work. Since the war started, Mr. Cramer has been dividing his time between the Baldwin offices in Kansas City, Chicago and Washington, in connection with negotiations with various branches of the Federal government and the Armed Forces.

R. L. Clark has recently been appointed manager of the Steam Specialties Department of The Strong, Carlisle & Hammond Company, succeeding R. L. Keech, who is now devoting all his time to the manufactur-



. . . our experience and laboratory facilities

Is your water conditioning equipment delivering the quality of water you must have?

Is its capacity sufficient for your requirements?

Are you satisfied with its operating cost . . . its efficiency?

If you are confronted with any such problems, or if you are planning the installation of additional equipment for any phase of water conditioning, we shall be glad to give you the benefit of our more than thirty years of experience without obligation.

We have prepared an exceptionally complete and comprehensive questionnaire which will enable you to give us full information about your present equipment and your requirements. This information, together with a sample of the water to be treated, will enable us to analyze your problem and submit unbiased recommendations.

Write today for a copy of this special questionnaire. There's no cost or obligation.

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4809-85 Tod Ave., East Chicago, Ind.
NEW YORK CATASAUQUA, PA. CHICAGO TULSA

GRAVER *Water Conditioning Equipment*

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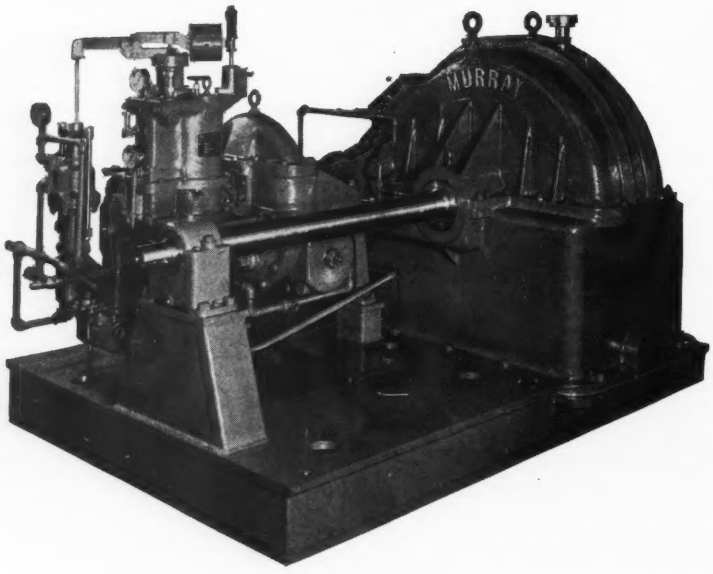
MURRAY TURBINES

give war industries adequate and dependable power facilities



EACH MURRAY Turbine shipped from this organization is consigned to a war plant. That is our production schedule for the duration. Our entire facilities are devoted to meeting high priority needs.

Even though you may not have a rating that entitles you to purchase a MURRAY Turbine now, it will pay you to investigate. Find out the advantages MURRAY design and construction offer. When the time comes that restrictions in deliveries are lifted, you will have an answer all ready for your turbine needs.

The same applies for MURRAY Boilers and Engines. Write today for descriptive bulletins.

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IRON WORKS COMPANY
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POSITION WANTED

Mechanical Engineer, aged 33, industrial and power experience. Started new High Pressure Powdered Coal utility as operator and control man. Desires plant engineer position in medium sized plant in Midwest. Am now employed. Address Box 1426, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

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HELP WANTED

POWER PLANT CHEMIST WANTED

Utility in midwest has attractive opening for power plant chemist. Salary from $2400 to $3000. Applicant should have some experience in coal and water analysis, and should furnish references and draft classification. Address Box 1427, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

ing division. Mr. Clark has been with the company for nearly twenty-five years. The company also announces that L. H. Boleky, 634 Wabash Bldg., Pittsburgh, Pa., will represent Strong Steam Specialties in Eastern Pennsylvania and West Virginia, replacing Fred Fernald, who recently passed away.

Francis O. Clukies has joined the sales staff of Robins Conveyors Inc., Passaic, N. J., and will specialize in products of the Mead-Morrison Division. He was with the Mead-Morrison Mfg. Co. for some 30 years before Robins bought out the materials handling end of that company. He will work out of the New York office of Robins.

Richard W. Murray has been appointed brush engineering representative for the Connecticut and Rhode Island territory by The Osborn Manufacturing Co. of Cleveland, Ohio. Mr. Murray will be located at 153 S. Main St., Wallingford, Conn.

John Easton has been appointed Director of the development and standardization activities of Whiting Corp., according to a recent announcement by Howard D. Grant, president of the corporation. Mr. Easton succeeds A. J. Brown, who has been appointed manager of the Pacific Coast Branch.

Ralph J. Cordiner has recently been appointed assistant to the President of the General Electric Co. and will have offices in New York City. Mr. Cordiner, who resigned in June as vice chairman of the War Production Board, was formerly president of Schick, Inc., of Stamford, Conn., prior to which he was manager of the appliance and merchandise department of the General Electric Company.

MANUFACTURERS' NEWS

American K. A. T. Corp. announces that Eimer and Amend of 633 Greenwich St., New York City, and Fisher Scientific Co. of 717 Forbes St., Pittsburgh, and of Montreal, have taken over the distribution of K. A. T. for use in laboratory water stills.

Worthington Pump and Machinery Corp. of Harrison, New Jersey, has acquired Ransome Machinery Co., of Dunellen, New Jersey, as a wholly-owned subsidiary of Worthington. Ransome, designers and builders of machinery since 1850, manufacture concrete mixers and road paving equipment that will augment the present Worthington line of portable compressors and contractors' air tools. Ransome welding positioners and turning rolls will also constitute a logical addition to the varied Worthington lines of general industrial and power equipment.

Through the addition of about a tablespoon of Vinsol, a pine wood resin, to each sack of cement, highways in at least 15 states, and concrete runways on airplane landing fields, have been made resistant to severe winter conditions.

To eliminate surface scale caused by freezing, thawing, and applications of salt for ice removal, chemists of Hercules Powder Co. have worked for five years in cooperation with various

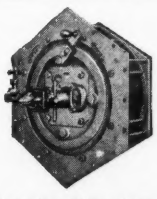
No. 5 in a series of tributes to America's War Industries

TWO-MILE CURTAIN OF HOT STEEL...GOING UP!

With desperate fury they dive in . . . trying to break through to bomb their target. But these Nazi bombers get just so far, then—WHAM! . . . they crash into a curtain of hot, tearing steel. For down there on the ground is a ring of American anti-aircraft guns . . . each one hurling more than a hundred two-pound shells two miles into the sky—every minute!

The performance of our high calibre, rapid-fire anti-aircraft guns is amazing. But even more remarkable is the production achievement that has made these guns possible.

To produce such intricate mechanisms on a mass scale was a stern challenge to American industry. Just how well this challenge has been met is, of course, a military secret. But on every fighting front, the mounting number of dead Nazi and Jap airmen is mute testimony to the job that has been done . . . a job that reflects the ability of America's industrial might to produce whatever is necessary for victory, be it planes, tanks, ships, shells or guns.



IN PLANTS OF ALL TYPES

TODD BURNERS

ARE WORKING FOR VICTORY

Wherever trouble-free, dependable combustion of liquid and gaseous fuels is a necessity . . . in war plants, in countless merchant and fighting ships . . . Todd Burners are delivering unsurpassed performance in the production of heat and power.

Buy MORE
War Bonds and Stamps

TODD SHIPYARDS CORPORATION

TODD COMBUSTION DIVISION

601 West 26th Street, New York City

NEW YORK · MOBILE · NEW ORLEANS · GALVESTON
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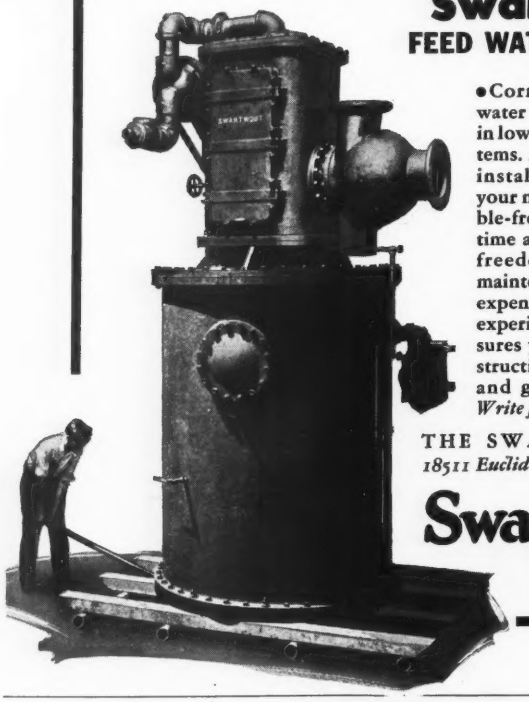
TODD BURNERS ★ ★ ON THE FIRING LINE OF AMERICA'S WAR PRODUCTION FRONT

GREATER fuel economy—
less trouble from scale and oxygen with

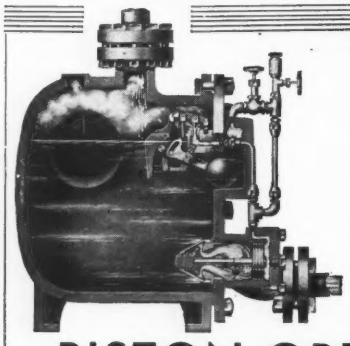
Swartwout
FEED WATER HEATERS



•Correct preparation of water is equally important in low or high pressure systems. A Swartwout Heater installation, tailored to your needs, gives you trouble-free results that mean time and money saved—in freedom from expensive maintenance and lower fuel expense. Swartwout's long experience in this field assures you sound, safe construction, ample capacity and guaranteed results. *Write for Bulletin S-18-D to*

THE SWARTWOUT CO.
18511 Euclid Ave., Cleveland, Ohio

Swartwout
Power Plant Equipment



Power Engineers
Can Be Absolutely Sure of Dependable Efficiency and Economical Durability by Specifying

NICHOLSON
PISTON-OPERATED TRAPS
for Super Pressures and Super Heat

Write for Catalog No. 941

See our Catalog in Sweet's

A positive, instantaneous, high pressure trap which occupies smaller space yet has greater capacity than any others available. The discharge valve is non-wire-drawing type, being entirely open or closed at all times—orifices of these traps range from 1" to 4" for all pressures up to 650 lbs., as compared with ⅛" to ½" used on the average trap. All valves, seats and working parts are of stainless steel for long trouble-free operation . . for Super-Pressures and Super-Heat in the Super-Power Plant.

W. H. NICHOLSON & CO., 160 OREGON ST., WILKES-BARRE, PA.

NICHOLSON *Traps*
THERMOSTATIC ▼ PISTON AND WEIGHT-OPERATED STEAM GASOLINE AND COMPRESSED AIR TRAPS ▼▼▼
CONTROL VALVES ▼ FLOATS ▼ MANDRELS ▼ STEAM AND AIR SEPARATORS

state highway departments, federal agencies, and the Portland Cement Association.

Fractional amounts, ranging from 2½ to 4½ parts in 10,000 (0.025 to 0.045 per cent) of the resin are added by cement manufacturers to the clinker during grinding. The resin is extracted from southern pine wood.

United States Steel Corp. announces the completion of arrangements with Defense Plant Corp., an R. F. C. subsidiary, for the operation during the war of the new Government-owned steel mill in Utah, substantial completion of which is now scheduled for the end of this year. Under the terms of the agreement, these facilities will be operated for the account of Defense Plant Corp. by Geneva Steel Co., a newly organized U. S. Steel subsidiary.

When completed, this will be by far the largest integrated steel mill west of the Mississippi, a plant of the most modern design, whose cost will approximate $180,000,000. The site of the main plant at Geneva, Utah, known as Geneva Works, embraces more than 1,600 acres.

Army-Navy "E" Awards

The Bristol Company,
Waterbury, Conn.

Great Western Division of The Dow Chemical Co.,
Pittsburg, Calif. Plant.

Taylor Instrument Companies,
Rochester, N. Y.

Westinghouse Electric & Mfg. Co.,
Mansfield, Ohio, Works,
Meter Division.

Maritime Commission "M" Award

Air Preheater Corp.,
Wellsville, N. Y.

American Chain & Cable Co.,
Reading Plant.

Cooper-Bessemer Corp.*
Grove City, Pa., Plant,
Mount Vernon, Ohio, Plant.

The Wm. Powell Co.
Cincinnati, Ohio

*Added star for sustained high achievement in production of war equipment.

NEWS FROM THE FIELD

Fuel-Testing Program

MADE POSSIBLE through a Congressional appropriation of $375,000, testing millions of tons of coal for the Army, seeking substitute fuels to replace those in which shortages exist, promoting the production of high-quality coke to feed the wartime blast furnaces, advising on storage and combustion problems, and producing gasoline and oil from coal are in the U. S. Bureau of Mines' expanded fuel-testing program for the 1944 fiscal year, according to an an-

FISHER'S ONE-MILLIONTH CONTROLLER

A significant milestone in the automatic control industry was reached with the completion of the MILLIONTH FISHER CONTROLLER. Since 1880 manufacturing plants, power plants, chemical and process industries — yes, EVERY PHASE of industrial activity has benefited from the advantages of automatic control made possible by the many varied types of Fisher products designed for every requirement. Fisher Controller, Serial Number 1,000,000, Type 4357-T, is now "on the line" in an aviation gasoline plant. Its operating performance for years to come is unquestioned, for like its 999,999 "brothers," it's a product of Fisher Engineering, Research and Manufacture — a combination of "know how" that is recognized the world over.

At the present time Fisher's total production is requisitioned for war needs. To meet these needs, manufacturing facilities have been greatly expanded as evidenced by the fact that the last 500,000 Controllers have been produced in only 6 years time, whereas the first half million were produced over a 57 years period.

When conditions return to normal, Fisher increased production facilities will, without any reconversion delay, be turned to serving normal industrial needs.

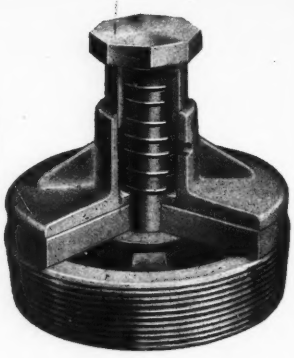
The extensive service background of Fisher Controllers is a firm foundation for their continual advance in the future.

ARMY E NAVY

FISHER GOVERNOR COMPANY

1016 Fisher Bldg. • MARSHALLTOWN, IOWA

Can you afford to run racing STEAM-WASTING PUMPS?

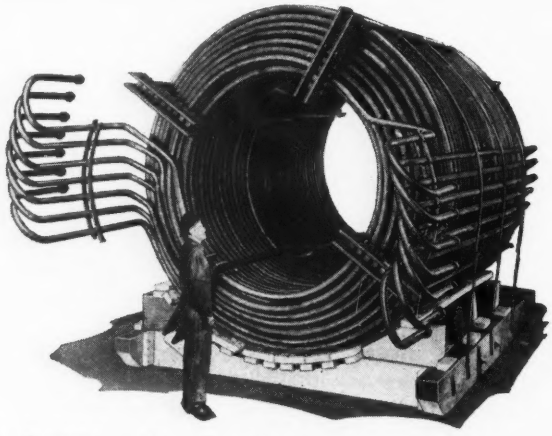


S-l-o-w 'Em Down With COMBINATION NON-TILT VALVES

If your plant operates two or more reciprocating pumps—Boiler Feed, Vacuum, Condenser, General Service—the chances are that you can save up to 15% in steam and cut maintenance cost at the same time by using COMBINATION Pump Valves. They lift straight, close quickly, prevent racing and hammering, eliminate many pump repair bills. Ask for descriptive bulletin.

They Match the Fine Performance of Combination Silent Check Valves.

COMBINATION PUMP VALVE CO.
846 WIOTA STREET, PHILADELPHIA 4, PA.



To Aid War Production—

A 1¾ MILE NESTED SPIRAL COIL

Typical of the way in which Rempe engineering and production facilities are contributing to the war effort is this giant multiple spiral coil recently delivered to a machinery fabrication plant.

Built of Grade A-106 seamless steel tubing, with seven separate circuits, this large heating coil contains more than 1¾ miles of pipe and weighs 22,000 lb.

Rempe Coils and Bends are made from any material to customers' specifications —are widely favored by engineers for Heat Exchangers, Feed Water Heaters, Coils for Refrigeration Machines, Chemical Processes, etc. Write for estimates.

REMPE CO.
342 No. Sacramento Blvd., Chicago

nouncement from the Department of the Interior.

Under "scientific investigations" the Bureau will continue to test coal and coke for the new blast furnaces of the Defense Plant Corp., produce motor fuel and oil from coal by hydrogenation, study the substitution of colloidal, or coal-oil mixtures, for fuel oil, seek to prevent slag erosion of boiler tubes in electric power plants, and review the storage and combustion problems of war plants.

The service functions include technical advice to other Federal agencies on the installation, replacement, and operation of fuel-burning equipment, the sampling and inspection of fuel purchased for the Government, and the analysis of coal samples. Already handling all coal purchases for the Army, some 10,000,000 tons a year, the Bureau this year also will test water used in Army boilers, which accounts for the increase in the appropriation.

In sampling and inspecting fuel to guide the Government in its selection, purchase, and use, the analyses upon which the Government purchases are based are published and thus made available to all coal users. This information is of particular value when wartime shortages require the consumer to change to other sources and types of coal. Conversions from oil to coal-burning equipment have fostered many new problems, including the necessity for testing new apparatus to determine whether it meets performance specifications, it was shown.

A Bureau of Mines project holding perhaps the greatest current interest is the hydrogenation of coal and water gas to produce liquid motor fuel and fuel oil. The demands of the war and the lack of adequate transportation facilities, causing critical shortages of petroleum products in certain sections of the United States, have focused public attention on the diminishing discoveries of new oil fields.

Coal reserves of the nation are virtually unlimited, and the objective of the Bureau's work is to determine which coals and which methods are the best suited for producing liquid fuels. One small laboratory-scale pilot plant for the direct hydrogenation of coal by the Bergius method is in operation, and the Bureau is ready to install and operate an industrial-scale pilot plant if funds are provided. Another small laboratory-scale plant which will synthesize oil by combining carbon monoxide and hydrogen by the Fischer-Tropsch process is under construction at the Bureau's Pittsburgh Experiment Station. Research in this plant will provide the technical information needed for designing and constructing an industrial-scale pilot plant which will furnish the blueprint for commercial plants.

Stoker Sales

THE U. S. BUREAU of the Census recently released statistics showing that factory sales of Class "A" stokers, ranging in size from 61 to 1201 lb of coal per hour, more than doubled in the first six months of this year compared with the same period in 1942. In the first six months Class "A" sales totaled 11,251 units with 5401 in 1942 and 4573 in 1941.

Most of the Class "A" installations this year have converted oil burning plants to coal, principally in the Eastern states where the fuel oil supply has been far below demand.

Class 5 (over 1200 lb coal per hour)

RATING INCREASED BEYOND PRESENT LIMITS

"Pinwheel Action"

A NEW GAS BURNER PRINCIPLE — PERMITS GREATER HEAT RELEASE PER CUBIC FOOT OF FURNACE VOLUME

Coppus-Dennis FANMIX Gas Burner utilizes the Dennis principle of combining gas with air in a perfect ratio. "Pinwheel Action" produces complete combustion without impingement — truly "radiant heat". A constant temperature exists throughout the furnace; no drifting hot-spots.

One simple change in your equipment — installation of FANMIX — will give you the extra thru-put you are undoubtedly looking for.

And here's real efficiency. With Coppus-Dennis FANMIX Burner, typical flue gas analysis shows over 11% CO_2, a fraction of 1% of O_2, no trace of CO., when burning 1000 B.T.U. natural gas.

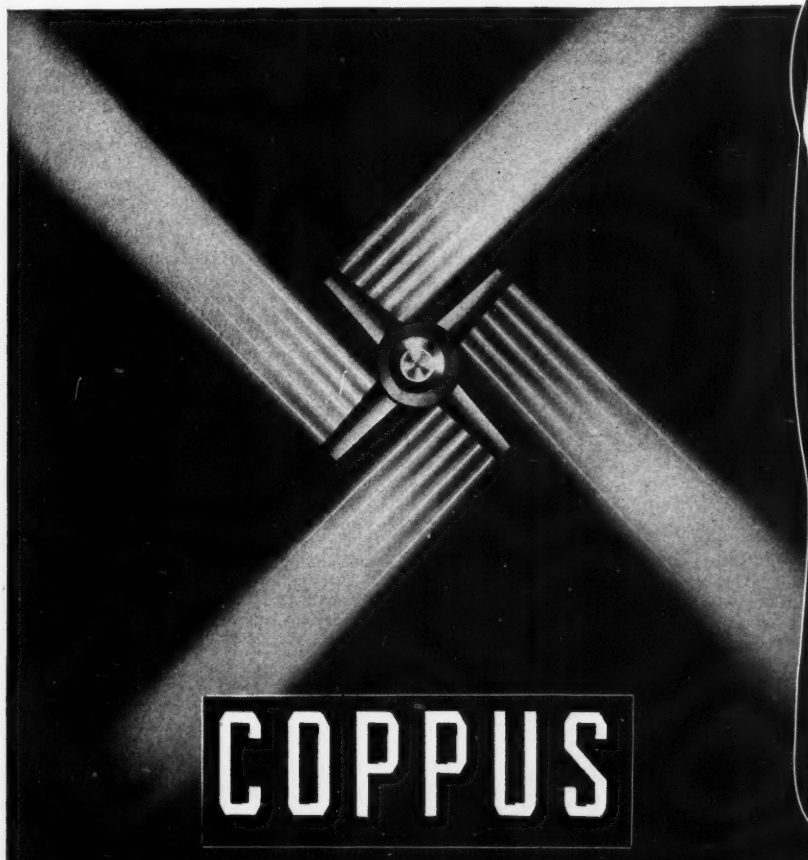
"PINWHEEL ACTION" FOR PERFECT MIXTURE

The energy in gas under pressure does the work. Gas escaping from radially-spaced orifices in driving arms, rotates the fan; this in turn causes intake of air at right angles to the path of the gas. Gas and air are thus mechanically mixed in correct proportions for complete combustion.

GREATER HEAT RELEASE PLUS!

Bulletin 410-3 describes other FANMIX advantages: — smaller combustion space, less stack, no forced draft equipment needed, no cracking of wet gas, because driver arms stay below "cracking" temperature. A Coppus "Blue Ribbon" product — precision-engineered, precision-built.

COPPUS ENGINEERING CORPORATION
339 Park Avenue, Worcester, Mass.
Sales Offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in SWEETS' CATALOG

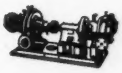


COPPUS

You'll get valuable ideas from these free bulletins on other Coppus Blue Ribbon Products

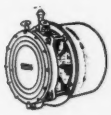
(Check the ones you want)

☐ Coppus Cable Manhole and Tank Ventilators. For confined working spaces. Bulletin 163-1.

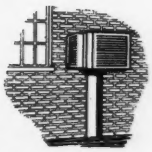


☐ Coppus Steam Turbines. 6 sizes (and prices) from 150 H.P. down to fractional. Bulletin 135-9.

☐ Coppus Heat Killers. Keep production up by keeping men cool. No stale air recirculation. Air is directed. Bulletin 160-5.



☐ Coppus Type C Turbo Blower. For undergrate draft. Bulletin 145-6.



☐ Coppus Air Filters. For engines and air compressors. Perfect, uninterrupted filtration. Bulletin F-310-4.

☐ Coppus-Dennis Fanmix Gas Burner (described in this ad).

Name .....

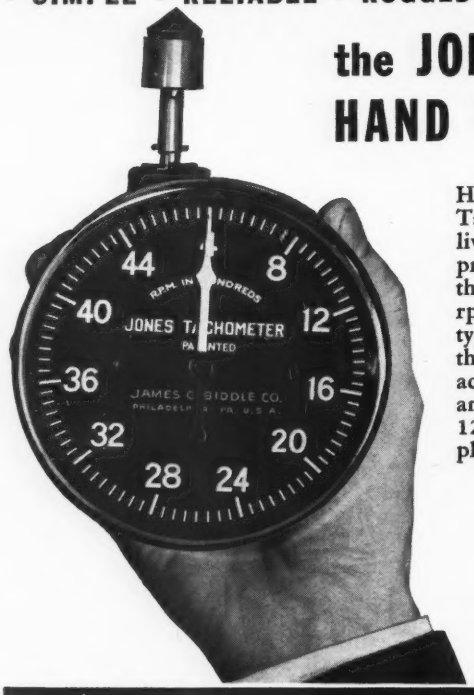
Company .....

Address .....

City ..... State .....

COPPUS BLUE RIBBON PRODUCTS DESIGNED FOR YOUR INDUSTRY . . . ENGINEERED FOR YOU

• SIMPLE • RELIABLE • RUGGED • MADE IN U. S. A. •



the JONES heavy duty HAND TACHOMETER

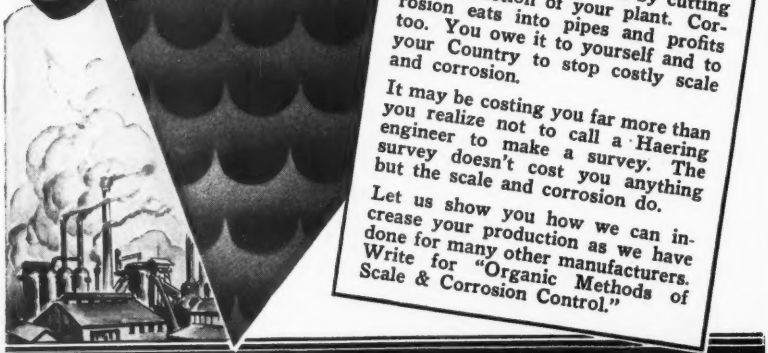
Here is an American-built Hand Tachometer available for delivery in accordance with your priority rating. We suggest this Tachometer for indicating rpm and surface speeds of all types of machinery in which the moving parts are readily accessible.* Available in single and triple range models up to 12,000 rpm. Furnished complete with case and accessories.

Write for new descriptive Bulletin 1710-PE

*Where moving parts are not readily accessible, as in turbines, centrifugal pumps, etc., we recommend our Frahm Vibrating-Reed Tachometers. Ask for Bulletin 1590-PE.

James G. Biddle Co.
1211-13 ARCH STREET *Electrical and Scientific Instruments* PHILADELPHIA, PA.

WE READ *Water*



Pipes clogged with scale clog the war effort of the Nation by cutting the production of your plant. Corrosion eats into pipes and profits too. You owe it to yourself and to your Country to stop costly scale and corrosion.

It may be costing you far more than you realize not to call a Haering engineer to make a survey. The survey doesn't cost you anything but the scale and corrosion do.

Let us show you how we can increase your production as we have done for many other manufacturers. Write for "Organic Methods of Scale & Corrosion Control."

D. W. HAERING & CO., Inc.
GENERAL OFFICES:
205 West Wacker Drive Chicago, Illinois.

or power size stoker sales show a slight increase this year over 1942 and 1941, with 839 units for the January-June months in 1943; 826 in 1942, and 591 in 1941.

Harbor Steam Plant Officially Accepted by Los Angeles

ON JUNE 17, 1943, the Harbor Steam Plant of the Bureau of Power & Light, City of Los Angeles, Calif., described in detail in the June, 1943, issue of POWER PLANT ENGINEERING, was officially turned over to the City of Los Angeles. The mayor of the city, the commissioners of Water and Power, representatives of the Los Angeles Chamber of Commerce and others gathered at the plant for this ceremony.

On July 15, the Bureau of Power & Light invited representatives of the principal contractors and suppliers of equipment for the Harbor Steam Plant to a luncheon and inspection tour of the plant. This meeting, of about 250 people, included representatives of a number of other municipal power plant organizations, such as those at Glendale, Pasadena, and other cities.

The 65,000-kw generating unit has been in operation carrying 48,000 kw, or approximately 75 per cent of rated capacity, with air cooling of the generator, as the hydrogen cooling has not yet been applied. It is understood that preliminary operations are proceeding very satisfactorily and it is expected that the tuning-up process will soon be completed and the station carrying full capacity.

Coal Research

REAPPOINTMENT of Julian E. Tobey as chairman of the Technical Advisory Board of Bituminous Coal Research, Inc., was announced recently by Howard N. Eavenson, B. C. R. president.

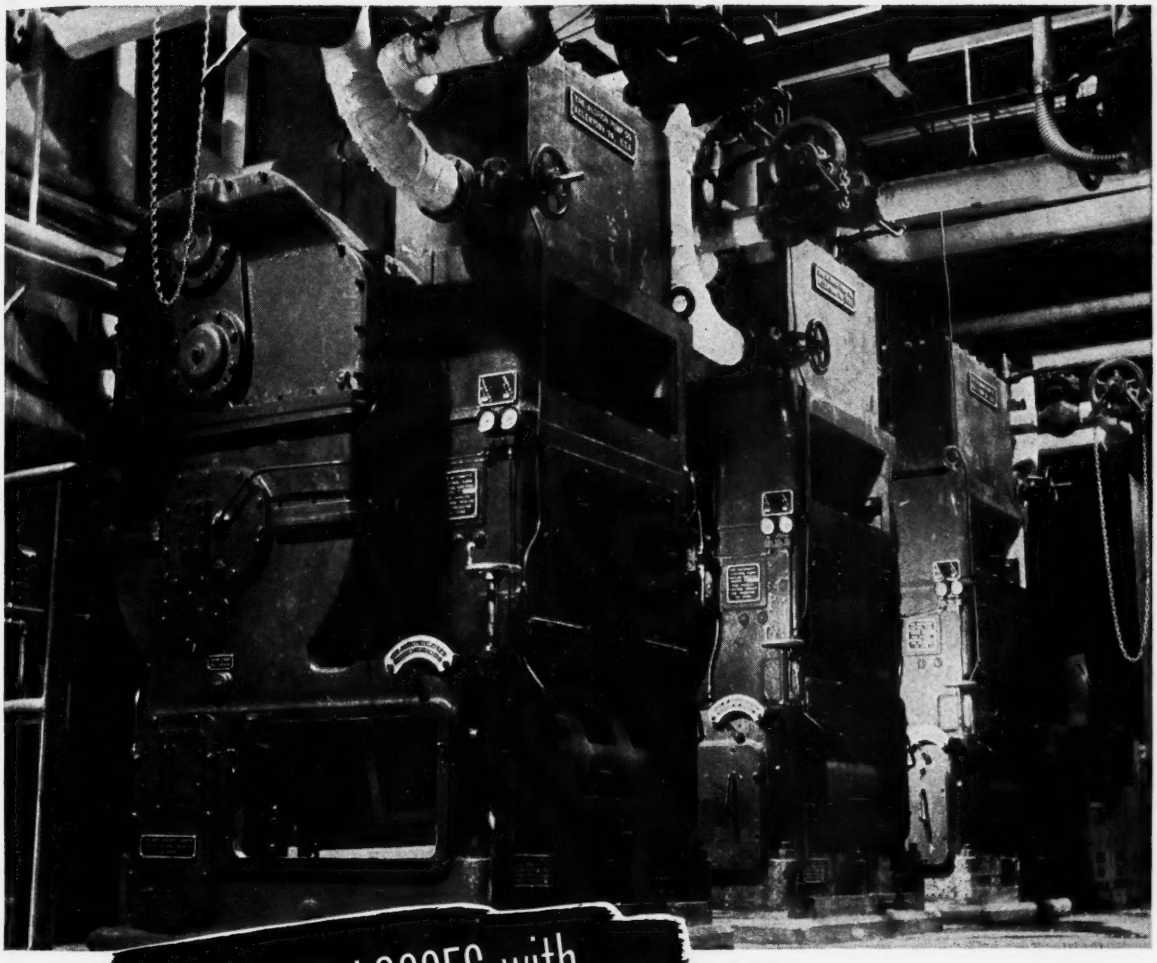
Mr. Tobey will continue active direction of the industry's research program aimed at the improved and increased use of coal in residential and industrial applications. He also continues as chairman of the Technical Executive Committee; he has held both positions since the Board was organized in March, 1941. Mr. Tobey is managing director of the Coal Bureau of the Upper Monongahela Valley Association, Chanin Building, New York City.

To facilitate the handling of an increasing number of B. C. R. research projects, each requiring careful consideration and discussion with the Battelle engineers who conduct the research, sub-committees were appointed by Mr. Eavenson on Hand-Fired Heating Equipment, Residential Stokers, Dustless Treatment, Railroad Locomotives, Gasification and Carbonization, and Industrial Utilization. The chairmen of the sub-committees constitute the Technical Executive Committee.

P.G.&E. Receives OCD Reward

A SPECIAL governmental award of honor has been given to the Pacific Gas & Electric Co. in official acknowledgment of its many substantial contributions to civilian defense by widespread and thorough cooperation with wartime control of lighting. The award, a new one just inaugurated by the Office of Civilian Defense, consists of a pennant and a certificate.

One item of cooperation for which



CUT POWER LOSSES with . . .

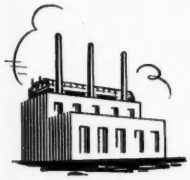
. . . ALDRICH-GROFF CONTROLLABLE CAPACITY "POWR-SAVR" PUMPS

Aldrich-Groff pumps on unit feed systems eliminate pressure and power losses common to throttling-type feed regulating valves and offer advantages of feed system simplicity, efficiency and mechanical reliability for small and medium installations at medium and high steam pressures.

Equally important overall power savings are effected by Aldrich-Groff pumps on de-superheater feed service in connection with high pressure topping units for power stations of any size.

The three Aldrich-Groff 3¼" x 0 to 6" variable stroke vertical triplex pumps shown above are in service in a mid-western central station employing the unit system for main boiler feed. Two are driven by constant speed motors and the third by a constant speed steam turbine. Power consumption is almost directly proportional to pump delivery.

The 6" stroke — 3¼" plunger pump is a 100 HP unit and when operating at maximum speed can deliver 70,000 pounds of feed water per hour against 1025 pounds boiler pressure.



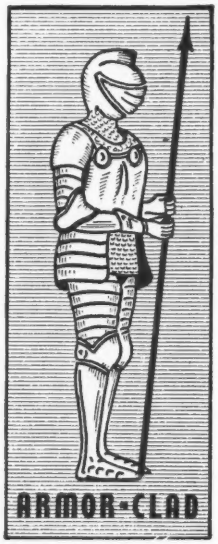
WRITE TODAY...

for bulletins and material giving full details, sizes and ratings of Aldrich-Groff Pumps.

THE ALDRICH PUMP CO. ALLENTOWN • PENNA.

REPRESENTATIVES: Birmingham • Bolivar, N. Y. • Boston • Chicago • Cincinnati • Cleveland • Denver • Detroit • Duluth • Houston • Los Angeles • Pittsburgh • Portland, Ore. • St. Louis • San Francisco • Seattle

PROTECT YOUR FURNACE WALLS WITH ARMOR-CLAD



Before placing your new furnace walls or linings into service, or resuming heat in your shut-down furnaces, be sure to apply a coating of heat setting monolithic

ARMOR-CLAD

These amazingly effective, economical, easily applied protective coatings give long life and freedom from costly and frequent repairs and power failures, by providing a monolithic, streamlined, impenetrable, vitrified lining to all of your refractory walls.

Armor-Clad protects against Slag adhesions, Flame penetration, Spalling, Acid or Basic attack and Cold Air infiltration.

Armor-Clad Coatings are in successful use by many of the Nation's most important industrial and metallurgical plants, in the Arsenals of Democracy, in the Navy, Transports, and Ships at Sea, **Wherever America's Furnaces are on the Firing Line!**

• *Send for Booklet and Armor-Clad Tangible Proof!*

ARMOR-CLAD COMPANY
EMIL A. SCHROTH, PRESIDENT
39 Hyatt Avenue **Newark, N. J.**

See what NUGENT FILTERS do to Lube Oil...

Nugent Duplex Filters are specifically designed to meet the demands of Diesel operators who can't take a chance with power interruptions. The thoroughness with which these Duplex units remove dirt and foreign material from lubricating oils *without* removing the essential additives is shown at the left.

The dark tube of dirty crankcase oil was taken from a 300 H.P. gas engine before installing a Nugent Filter. The other tube shows a sample of oil from the same engine after the installation of a Nugent Filter, and operating 1,344 hours before cleaning.

Get the full story on Nugent Filters. Write today for details.

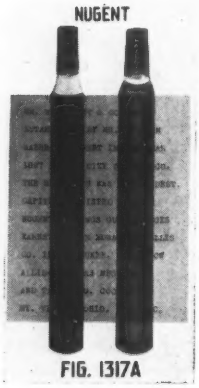


FIG. 1317A

FIG. 1317B

WM. W. NUGENT & CO., INC.
423 N. Hermitage Ave.
Chicago 22, Ill. Est. 1897

the award was made was the shielding of at least 50,000 street lights in Northern and Central California by P.G.&E., to help eliminate or control the skyglow. Special efforts were made to comply fully with the regulations, yet retain as much illumination as possible in the interests of public safety and accident prevention.

The company has also been of great assistance to the public and the authorities in showing its customers how to use light at home and in commercial establishments and at the same time maintain an effective blackout. One of the company's illuminating engineers has been serving with the OCD to lend a hand with blackout and dimout problems.

Sims Retires from Commonwealth Edison

WILLIAM F. SIMS, chief electrical engineer of Commonwealth Edison Company, retired August 13 after a total of 32 years of service, the utility has announced. He was honored by his associates at a luncheon in the Union League Club. George M. Armbrust succeeds the veteran and W. G. Kelley will become assistant chief electrical engineer.

Receiving his electrical engineering degree with the first graduating class at Armour Institute of Technology in 1897, Mr. Sims started his business career with the old Chicago Telephone Company and entered Commonwealth Edison employ in 1901 as an assistant engineer. Leaving the utility five years later, he worked in several engineering capacities, but returned to the Edison Company in 1916 as a field engineer. He became engineer of inside plant in 1930 and was elevated to chief electrical engineer two years later.

Mr. Armbrust, also a former Armour student, became associated with the company in 1902 as a draftsman. He was successively promoted to chief draftsman, staff engineer and system development engineer, and in 1932 was named assistant chief electrical engineer. A graduate of Massachusetts Institute of Technology, Mr. Kelley started his service as an engineer in 1901 and rose to the position of plant design engineer in 1932.

Turbine Specifications Restricted

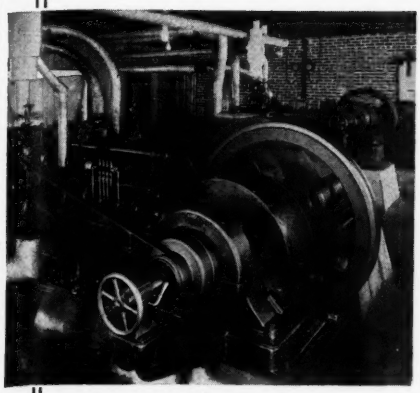
ANNOUNCEMENT comes from Government authorities that specifications designed to conserve materials in the construction and installation of steam turbines for land use were issued on July 28 by the War Production Board in Schedule VI to Order L-154.

The order provides that no producer shall install on any steam turbine for land use, with certain exceptions, sheet metal lagging, asbestos or other high temperature molded insulation, ornamental trim, gage equipment larger than specified sizes or larger than the minimum practicable size, duplicate instruments, more than a single oil pump or tubing or other special materials not customarily furnished by the manufacturer for the conditions under which the turbine is to operate.

Grand Coulee Starts New Unit

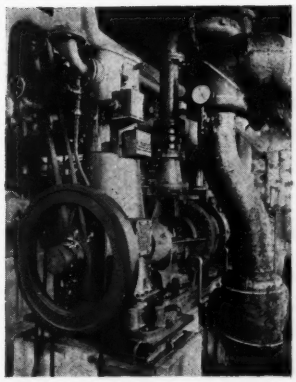
GRAND COULEE DAM'S fourth massive generator has recently been put into service adding more than a hundred

For Many Drives



STEAM ENGINE IS THE BEST POWER

BEST *because* of its dependability, *because* of its economy, *because* of its flexibility

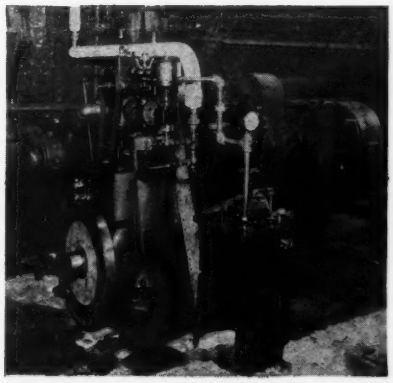


NO one questions the dependability of the Troy-Engberg Steam Engine—industry's outstanding power drive of this class. Our records show hundreds of these units operating fifteen to twenty years, even longer, without need for major repairs.

When plant heat balances are right, the economy of this engine is exceptionally high. It takes only a year or two to pay off the entire cost; there is a return of from 17 to 430% on the investment.

As for its flexibility . . . consider the step taken not long ago by a very large public utility which installed 24 Troy-Engberg Steam Engines as drives for its 48 stokers. In this installation, the speed of each engine is automatically controlled.

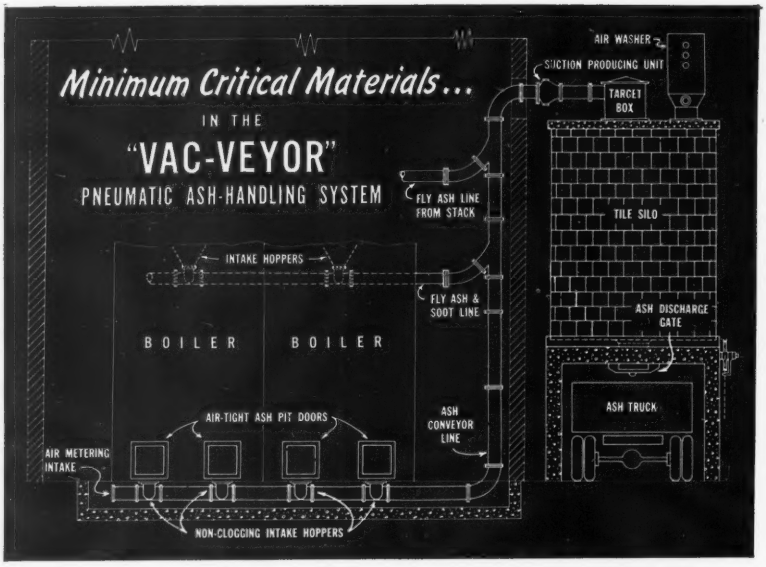
Dependability, economy, flexibility are combined with plus values such as high-starting torque, heavy overload capacity, explosion-proof construction, oil-free exhaust. These are the advantages of the Troy-Engberg Steam Engines.



TROY ENGINE & MACHINE CO.

Established 1870

856 Railroad Avenue Troy, Pa.



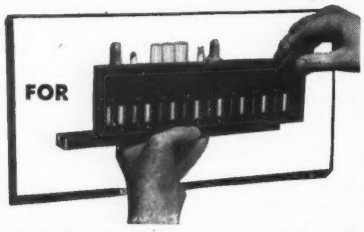
Write us today for complete details

Designed to fill today's needs in either new installations or oil-coal conversion, this pneumatic ash handling system offers numerous advantages.

BEAUMONT BIRCH COMPANY
1505 RACE STREET PHILADELPHIA, PA.

MANUFACTURERS AND ERECTORS OF COMPLETE COAL AND ASH HANDLING SYSTEMS

WHAT'S THE RIGHT pH



REFRIGERATING BRINES?

CORROSION of both galvanized and iron parts is best inhibited by holding the pH of the brine at 7.5 to 8.0.*

For quick, accurate determination of pH, use the Taylor pH Slide Comparator Model T-O. The outfit consists of base and slide of durable plastic. It is light in weight, compact, simple to operate. All Taylor color standards carry an *unlimited* guarantee against fading.

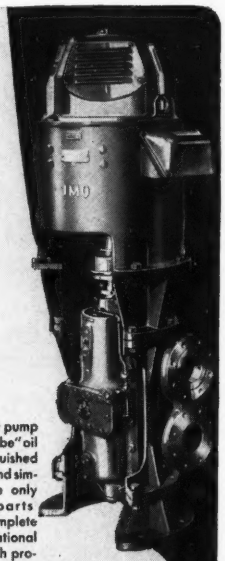
MODEL T-O Price $16.00 f.o.b. Baltimore.

See your dealer or write direct.

*Plus treating brine with 100 pounds sodium dichromate per 1000 cu. ft. for calcium brines, and 200 pounds per 1000 cu. ft. for sodium and mixed brines.

W. A. TAYLOR AND CO.
7301 YORK RD. • BALTIMORE-4, MD.

The **MOST PUMP** *in least Weight & Space*



IMO
I MOVE OIL

The De Laval-IMO pump for fuel oil and "lube" oil services is distinguished by compactness and simplicity. There are only three working parts which are in complete hydraulic and rotational balance and which propel the oil without pulsation, like a piston moving steadily forward. There are no valves, no gears, no cams and no reciprocating parts. The one packing is under suction pressure only and is easily accessible. Any quantity of oil is delivered against any pressure.

Ask for Publication I-111

IMO PUMP DIVISION
of the De Laval Steam Turbine Company
Trenton, New Jersey

thousand kilowatts to the capacity of this plant, constructed and operated by the Bureau of Reclamation under the Department of the Interior. Two additional large generators are being installed at Grand Coulee for service before next February.

The rated capacity of the Grand Coulee plant, with the latest addition, is more than 600,000 kw. This total includes two generators of more than 70,000 kw each, transferred from Shasta Dam in California and which are now in operation. The capacity is second only to Boulder Dam as the world's largest hydroelectric plant, and with three additional machines installed by 1945 the capacity would be increased to nearly 950,000 kw.

About 95 per cent of the power generated at Grand Coulee and transmitted by the Bonneville Power Administration is served to customers engaged in war work, including the production of 30 per cent of the nation's aluminum pig capacity, aluminum sheet, ships, carbide, steel, magnesium, sodium chlorate and ferro-alloys. In addition, the Government network is serving many military establishments.

Simplified Safety Valves

NATIONAL BUREAU OF STANDARDS has reported that a proposed simplified practice recommendation for iron and steel pop safety valves has been submitted to producers, distributors, users, and others interested for approval or comment. The proposed recommendation includes iron body, carbon steel body and alloy steel body, pop safety valves, intended primarily for land steam service.

The development of this recommendation was undertaken at the request of the Shipbuilding Division of the War Production Board in cooperation with the Segment Committee of the Valve and Fittings Industry Advisory Committee. The need for it was made apparent when an analysis of the requirements of claimant agencies for safety valves disclosed that all the needs of these agencies could only be met by reducing the variety of safety valves which the industry was being called upon to make.

Indications are that the simplified list will satisfy 95 per cent of the requirements for these valves, considering models, inlet sizes, outlet sizes, connections. The variety will be reduced from approximately 3000 to 200.

Copies of the proposed simplified practice recommendation may be obtained upon request to the Division of Simplified Practice, National Bureau of Standards, U. S. Department of Commerce, Washington 25, D. C.

Soft Water to Small Communities

SPEAKING BEFORE the Cleveland meeting of the American Water Works Association, S. B. Applebaum, vice president, The Permutit Co., described a new community water softening device which takes mineral-laden hard water, spirals it through an inverted steel cone and sends it out soft. This water softening device, called the "Spiractor" because water flows through it spirally, solves the old problem of disposing of sludge formed during the softening process. The principal bothersome minerals in hard water are calcium and magnesium; when these are precipitated out by lime treatment they form a messy sludge which is frequently dumped into a nearby stream or on adjacent ground, making

MORE PROOF THAT IT IS MORE ECONOMICAL TO GENERATE YOUR OWN POWER

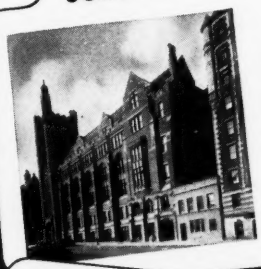
with SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINES

TODAY, the availability and assurance of an ample supply of electric power frequently surpasses in importance the cost of obtaining it. *Tomorrow*, the cost of power will be a deciding factor in the profitable operation of any business.

Skinner engines have been installed in practically every known industry. In addition to enjoying a dependable power supply, the users of Skinner "Universal Unaflow" Steam Engines pictured here, like hundreds of others, are further benefited. By generating their own electric current instead of buying it, these owners have saved, and will continue to save, thousands of dollars in annual power costs.

What we have done for others, we can probably do for you. Selection of the proper size and type of "the most economical steam engine built" may be made for your particular requirements. Now is the time to think about and plan for post-war power. Our research and engineering departments are available now to discuss your plans for the future.

SCHOOL



Famous college in New York City. Four horizontal "UNIVERSAL UNAFLOW" Steam Engines, with 3-wire D-C generators of 1100 kw. total capacity. Steam pressure 150 psi., sat.; back pressure 0-5 psi. Installed 1923, 1938. Exhaust steam used for building heat.

DAIRY

Nationally-known milk plant in Chicago, Ill. Two horizontal "UNIVERSAL UNAFLOW" Steam Engines; one driving 250-kv.a., 3-ph., 60-cy., 240-v. A-C generator, belted exciter; one rated 240 hp., driving horizontal ammonia compressor. Steam pressure 150 psi., sat.; back pressure 0-3 psi. Installed 1928. Exhaust used for building and water heating.

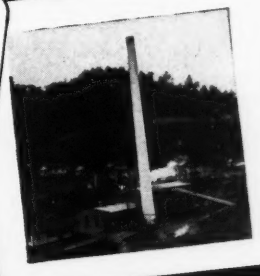
CONFECTIONERY

Large candy manufacturer in St. Louis, Mo. Two horizontal "UNIVERSAL UNAFLOW" Steam Engines, driving 375-kv.a., 3-ph., 60-cy., 208/120-v., 4-wire A-C generators, with V-belted exciters. Steam pressure 150 psi., sat.; back pressure 0-7 psi. Installed 1928. Exhaust steam used for building heating and refrigeration.

BREWERY

Well-known brewery in Cincinnati, Ohio. Three horizontal "UNIVERSAL UNAFLOW" Steam Engines, with 125-v. D-C generators; one 125 kw. (1937) and two 200 kw. (1942). Steam pressure 115 psi., sat.; back pressure 0 psi. or condensing.

COLLIERY



Modern coal mining plant in West Virginia. Two horizontal "UNIVERSAL UNAFLOW" Steam Engines, driving 750-kv.a., 3-ph., 60-cy., 2300-v. A-C generators, with V-belted exciters. Steam pressure 160 psi., sat.; back pressure 0-2 psi. Installed 1933.

INVEST TODAY IN BONDS FOR VICTORY

ARMY E NAVY

Proudly we fly the Army–Navy "E" Flag, awarded for excellence in production

Our production facilities, at present, are devoted entirely to building Skinner Unaflow Steam Engines for the war program.

Our Seventy-fifth Anniversary
1868 - 1943

SKINNER ENGINE COMPANY FOUNDED IN 1868 **ERIE, PA.**

The "HOWS" and "WHYS" of GASKET ENGINEERING

. . . from the Research Laboratory of "Gasket Headquarters"

Do you know all the factors bearing upon the selection of the proper gasket for a particular service?

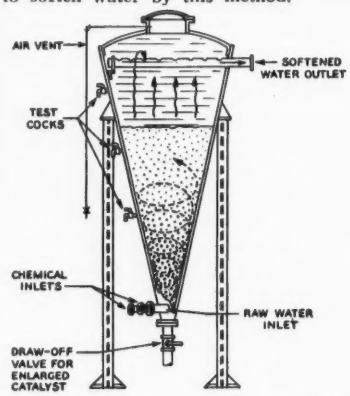
Enlightening information is contained in the current issue of "The Gasket"—the first of a series of technical bulletins to be issued by the modern Research Laboratory of the Goetze Gasket and Packing Company, oldest and largest manufacturers of industrial gaskets in America.

We will be glad to send these bulletins to you regularly, if you write on company letterhead, giving your position.

GOETZE GASKET & PACKING, CO., Inc.
17 Allen Avenue, New Brunswick, N. J.

Goetze for GASKETS

it unpleasant for other use. The Spiractor avoids the formation of sludge. Moreover, it requires comparatively small space and steel-saving small tanks compared with older cumbersome methods. It takes only five to ten minutes to soften water by this method.



The device consists essentially of an inverted conical container more than half filled with fine granules of the calcium carbonate catalyst. The hard water and the lime soda precipitant enter the bottom of this cone adjacent to each other and immediately mix together as the treated stream of water rises through the granular catalyst bed. Introduced tangentially, the chemicals and water rise through a spiral path which insures thorough and uniform contact between the catalyst granules and the treated water. The rate of flow is sufficiently high to keep the granular bed in suspended condition but low enough to prevent carryover.

The relatively insoluble products of the reaction deposit on the granules which causes the total catalyst bed to increase in volume in proportion to the amount of water treated. When the desired limit of the bed is reached some of the enlarged granules are drawn off from the bottom for disposal and fresh catalyst granules are charged in at the top.

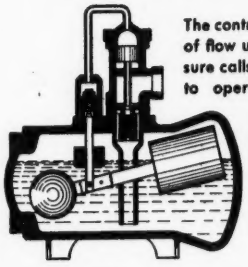
19th Exposition of Chemical Industries

CHEMICAL INDUSTRY already is consuming more than a billion dollars worth of allocated materials a year, almost wholly in war work, but the industry's leaders are constantly raising their sights. Many innovations will have been introduced by the end of the year, and the need for informing qualified personnel on critical phases of chemical progress is the principal basis for the 19th Exposition of Chemical Industries, to be held in Madison Square Garden, New York, December 6 to 11, next. It was inaugurated at the beginning of World War I, twenty-eight years ago.

It has been necessary to increase productive capacity for aluminum, magnesium, phenol, formaldehyde, methenal, toluene and many other basis products. The chemical industry was called upon to create and operate the new synthetic rubber industry, gearing it to produce 800,000 long tons the first year. High-octane gasoline is a new military requirement of undisclosed immensity. The inflation in explosives production taxes the imagination.

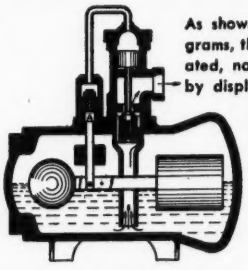
Construction of new plants, including expansion in metallurgical lines with chemicals and chemical products ear-

How to Handle Condensate Drainage at High Pressures

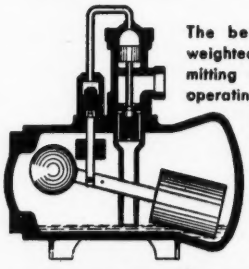


The control of a high rate of flow under high pressure calls for great force to operate the valve.

In the Cochrane Discharger this force is provided by a piston actuated by a pilot valve.



As shown in these diagrams, this pilot is operated, not by floats but by displacement bodies of different densities at either end of a beam which tilts with the rise and fall of the water level.

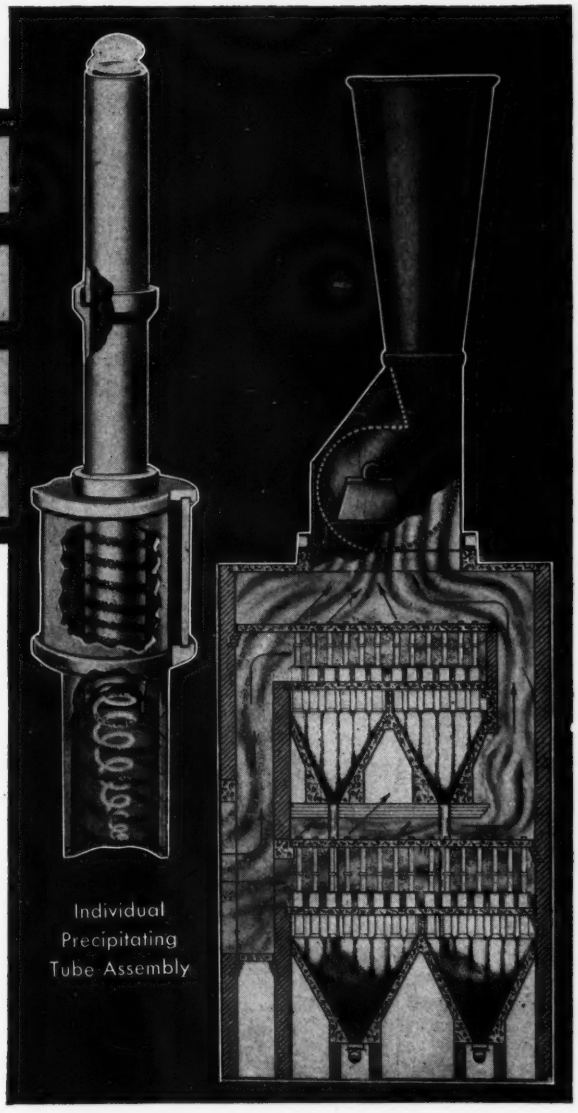


The beam opens the weighted pilot valve admitting steam to main operating valve which instantly opens main discharge valve to full opening, avoiding wire drawing or chatter.

Publication 2935 gives complete data.
COCHRANE CORP., 3123 N. 17th St. Phila. 32, Pa.

COCHRANE DISCHARGERS

AN IMPORTANT MESSAGE TO THOSE WHO NEED A DUST COLLECTOR NOW



Individual Precipitating Tube Assembly

In these times it is practically impossible to get delivery of a dust collector made of steel—for steel is a fighting material.

But you can get quick delivery, *without a priority,* of a Thermix CERAMIC Dust Collector because it is made of materials not needed for the war.

Instead of using steel for the tubes, they are made of fire clay so thick and rugged that they are even harder than steel, yet they weigh no more. Temperature changes and normal handling do not affect them.

In spite of the non-critical materials used, this new Thermix Dust Collector retains all the features which have resulted in the high efficiency of Thermix Steel Dust Collectors now used for the collection of fine dusts, powders and fly-ash in connection with over 40,000,000 lbs. of steam capacity per hour.

Another thing, these improved ceramic tubes eliminate corrosion. They are not affected by low temperature gases containing sulphur and can handle high temperature gases. This Dust Collector can be installed outside of the plant, if desired, without an additional protecting structure.

Write for bulletin and full particulars, or mail the coupon.

PRAT-DANIEL CORPORATION, Port Chester, N. Y.

General Sales Agents

Thermix Engineering Co., Greenwich, Conn.

Representatives in Principal Cities

Thermix Ceramic DUST COLLECTOR

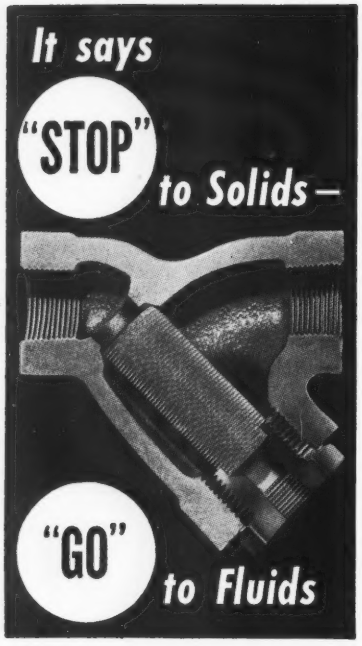
THERMIX ENGINEERING CO.
First Natl. Bank Bldg.,
Greenwich, Conn.

Without obligation on our part, you may send details about the Thermix Ceramic Dust Collector.

NAME .....

ADDRESS .....

CITY ..... STATE.....



Here is a BETTER Strainer to "police your pipelines"

- **FIRST**—*The Screen,* **a high-grade woven Monel wire basket that catches solids—lets condensate, oil or other fluids flow freely.**
- **SECOND**—*Finish.* **Cadmium plated inside and out for protection against corrosion.**
- **THIRD**—*Easily Cleaned.* **Blow-off bushing made for easy removal. Bushing and Screen come out together. Screen automatically aligns on reassembly.**
- **THOUSANDS IN SERVICE—Sold by over 100 Mill Supply Houses.**

6 sizes from ½" to 2" for pressures up to 600 lb. Reasonably priced.

See your supply house or write for Bulletin S-200.

YARNALL-WARING COMPANY
114 Mermaid Ave. PHILADELPHIA 18, PA.

YARWAY STRAINERS

marked for war is estimated close to four billion dollars in all.

Even more significant than the magnitude of accomplishments to date are some of the facts concerning the outlook for chemical industries in the months to come. New mills, mixers, tire building machinery and vulcanizers are expected to be authorized soon for a thirty million tire production in 1944. Though great emphasis has been laid on the derivation of synthetic rubber from petroleum, it is not generally known that nearly one-third of the "synthetic tires," consists of carbon black. Several new types of this reinforcing agent have recently been developed.

Much important work has been done in developing basic resources. Among them is a recently projected expansion in derivatives from by-product coke ovens, such as creosote oil, carbolic acid, heavy oils and pitch.

Plans for Conservation

WORK is going forward rapidly to organize the drive for conservation of fuel, manpower, equipment, and materials for the war effort referred to last month. A broad program covering coal, petroleum, natural and manufactured gas, water, communications and transportation industries is being proposed. Every unit that can be saved means that our national energy pool is strengthened just that much. Every manhour saved in the production of electricity, transportation, and communications is a manhour that can be used for something else. The overall campaign will be directed by an inter-agency committee consisting of OWU Director J. A. Krug, Deputy Petroleum Administrator for War Ralph K. Davies, Deputy Solid Fuels Administrator for War H. A. Gray, ODT Director Joseph B. Eastman and their assistants. They are calling upon the industries concerned to join in a broad voluntary conservation campaign. They point out that cooperation of these industries in asking the public to use their services only as absolutely necessary represents a real sacrifice by them.

The American public is urged to appreciate that sacrifice and to give them and the war effort enthusiastic cooperation as this campaign develops. It is expected that the program will get under way in early September. The Committee has issued specifications for various types of lighting to promote the program. All the various advertising media will be used to give publicity to the idea. Once again it is pointed out that so far as the power industry is concerned, the installed generating capacity, together with that now under construction, is ample to meet all foreseeable needs, but it is essential to save the use of electricity wherever possible in order to reduce directly or indirectly the demand for materials, tools, transportation, and manpower.

Central Station Service to Cost $500,000

UNITED STATES Corps of Engineers, Area Engineer Office, La Porte, Ind., has plans for installation of central station power supply at ordnance plant at Kingsbury Heights, La Porte County, to replace service heretofore secured from an isolated plant, equipped with three Diesel engine-generator units and accessories, and which is now scheduled for emergency service, it is understood,

How to De-Scale Your Transformer Coils SAFELY

Next time you have to clean your transformer cooling coils, save time and money by doing the job the fast, effective Oakite way.

Simply circulate a recommended solution of Oakite Compound No. 32 through coils as directed. Flush thoroughly . . . then neutralize. You will like the way insulating lime-scale and rust deposits are speedily yet **SAFELY** removed. Heat transfer efficiency is fully restored so that temperature of cooling water upon discharge from transformers is uniformly cool.

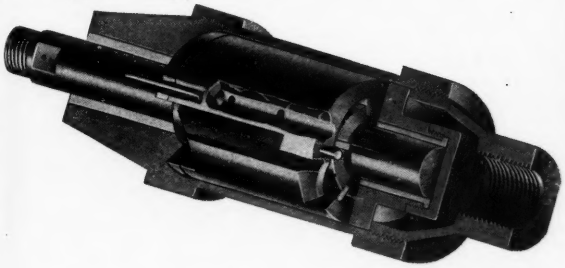
GET YOUR FREE COPY!

Concisely edited for busy power plant superintendents and engineers, this newly revised 20-page cleaning manual describes safe, fast, low-cost methods for de-scaling such other equipment as Diesel jacket-water coolers, surface condensers, heat exchangers, "lube" oil coolers. Write for your **FREE** copy today!

OAKITE PRODUCTS, INC.
23 Thames Street, New York 6, N. Y.
Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE *Specialized cleaning*
Buy Bonds for Victory
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

It takes GUTS!



To do the job of a fighting Marine, it takes something down inside. And, to do the tough job that a tube cleaner encounters, it takes something down inside. In Airetool Tube Cleaner motors you find that extra something. It is a unique power seal that saves power for the job to be done.

This Airetool power seal permits the use of heavier cutter head combinations to combat severe deposits. Motor will not stall even when loaded down to 50 R.P.M. Picks up quickly when power is applied.

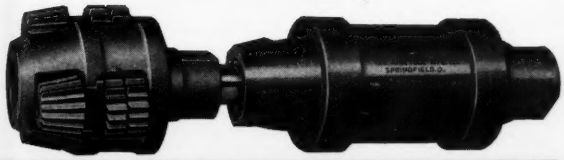
Quick, thorough tube cleaning depends on the "guts" of the motor used. Select Airetool for better results!

Airetool Tube Cleaners are made for straight or bent tubes 1/2" to 20" I.D. All types of cutter, drill and brush heads are available.

AIRETOOL TUBE EXPANDERS

Precision-made, long-lasting Airetool Tube Expanders are made for every size and type of tube. Special types for unusual conditions. Right-angle or universal drives where the tube opening is hard to reach.

WRITE FOR BULLETIN PP-14

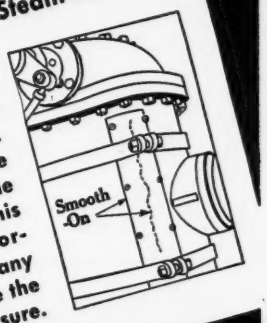


AIRETOOL
MANUFACTURING CO.
SPRINGFIELD, OHIO
Representatives in Principal Cities
New York Address, 50 Church St.

SMOOTH-ON REPAIR RECORDS

Repair of Steam Chest

The SMOOTH-ON repair of this long crack was reinforced by a patch plate and supporting straps or bands. The plate is held in place by machine screws, and the repair, strengthened in this manner, has been thoroughly successful in many similar instances where the apparatus is under pressure.



FOLLOW THIS SERIES OF SMOOTH-ON SAVINGS

This repair is typical of many instances in which the life of important and expensive apparatus has been saved and extended for many years by means of SMOOTH-ON No. 1. Note that no heat nor dismantling of apparatus was necessary, nor were any special tools required. Cylinder heads, pump casings, shells of evaporators, heaters and process apparatus, engine water jackets, and similar equipment may be lastingly repaired in the same manner.

And SMOOTH-ON has other helpful uses, too, for this many-purpose iron repair cement stops leaks in piping, joints, seams, etc., and tightens loose parts of apparatus, fixtures, tool handles, etc.

Be sure to buy a can of SMOOTH-ON without delay, so you will be prepared to make necessary war-time repairs speedily and effectively.

FREE

Repair Handbook Shows How

40 Pages, 170 Diagrams, simple practical instructions for ingenious repairs to plant equipment, pipe lines, structures. Based on experiences of engineers all over the country. To obtain your FREE copy, just fill in and mail the coupon.

Get Smooth-On No. 1 in 7-oz., 1-lb., 5-lb., 25-lb. or 100-lb. container from your dealer, or if necessary, from us. For your protection, insist on SMOOTH-ON, used by engineers and repair men since 1895.

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Please send the FREE Smooth-On Handbook.

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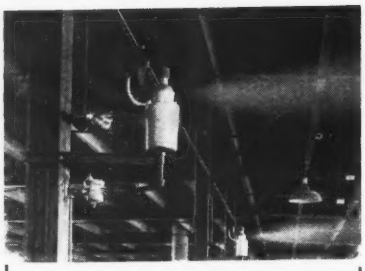
Do it with SMOOTH-ON
The Iron Repair Cement of 1000 Uses



CUT THE "BABY LIGHTNING" HAZARD,

improve working comfort, with

ARMSTRONG HUMIDIFICATION

GOOD NEWS FOR PLANTS that have fire hazard due to static electricity ("baby lightning"): you can get rid of this and also improve human working comfort by installing Armstrong Steam-Type HUMIDIFICATION.

You also end other dry-air evils due to winter heat, such as fiber breakage, paper shrinkage, warpage and checking of wood, etc. In offices, HUMIDIFICATION raises personal efficiency, cuts winter colds, improves paper handling.

Simple, practical, quiet, high-capacity; connected to steam lines like a unit heater. As low as $100 for 40,000 cu. ft. capacity. Used in hundreds of leading plants. Nothing like it on the market. Ask for literature.

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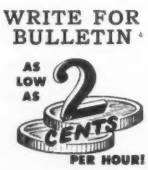


ARMSTRONG STEAM TYPE HUMIDIFIERS

in future. New installation will include three power substations, transformers, switchgear and auxiliary equipment, as well as certain transmission and distribution line construction, and is reported to cost approximately $500,000. A contract for building construction has been let to Todd & Brown, Inc., 9 Rockefeller Plaza, New York, N. Y., and is scheduled to be placed under way soon. The La Porte Gas & Electric Co., La Porte, it is said, will furnish power supply for the new installation, and will make connection with power substations and high-tension lines.

Power Projects Authorized

WPB, J. A. KRUG, director of war utilities, has authorized expansion in a number of power plants in different parts of country during coming months, entire development to total about 500,000 kw additional capacity. The projects will include the following:

Southern Indiana Gas & Electric Co., Evansville, Ind., to carry out expansion in local steam-electric generating station, with installation of a new 20,000-kw turbine-generator unit and auxiliary equipment. Work is scheduled for completion in 1944, and will include addition to switchyard at generating plant and extensions in transmission lines.

TVA, Knoxville, Tenn., will make extensions in several hydroelectric generating stations, including dam construction and installation of additional hydraulic turbines and electric generators to a total rating of 100,000 kw. Extensions also will be carried out in power substations, switching stations and transmission lines in different districts.

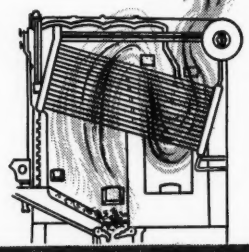
Municipal Electric Department, Jacksonville, Fla., has received permission to proceed with expansion in its municipal generating station on Talleyrand Ave., previously referred to in these columns. Work will include installation of new high-pressure boiler and accessories, for which contract has been awarded to Combustion Engineering Co., New York, N. Y., on bid of $159,637; new unit will have a generating capacity of 225,000 lb of steam per hr. Contract for installation has been let to Rust Engineering Co., Clark Building, Pittsburgh, Pa. Other work will include installation of a 15,000-kw turbine-generator unit, and auxiliary equipment, entire project reported to cost close to $700,000. Further contracts, it is said, will be made in future. Work will be completed in 1944. Burns & Roe, Inc., 233 Broadway, New York, N. Y., is consulting engineer.

Gulf Power Co., Pensacola, Fla., will make extensions in distribution system and will construct a new steam-electric generating station with capacity of 20,000 kw. This program is scheduled for completion in 1945.

Another Florida utility company, Florida Power Corp., St. Petersburg, has been authorized to make extensions in local steam-electric power plant, work to include a new 25,000-kw turbine-generator unit, boilers and auxiliary equipment. Project will include additions to transmission and distribution lines, power substations, etc. Likewise, it is expected to be completed early in 1945.

Board of Public Service, San Antonio, Tex., has received authority for addition to municipal power station, to increase capacity by 30,000 kw, installation to include turbine-generator, boilers and accessories. Completion is scheduled late in 1944.

XZIT means OUT



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XZIT is fed into the fire-box, and cleans while the boiler operates. Continued use prevents further carbon accumulation, increases heat transfer, reduces smoking, and saves maintenance time and labor.

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HELPFUL BULLETINS

Practical answers to many wartime problems of plant operation and maintenance are found in the engineering bulletins offered by manufacturers. For your convenience we publish the following summary of helpful literature available. To obtain copies of the bulletins and catalogs described, simply indicate the paragraph numbers on coupon on next page, detach and mail.

BOILER PLANT EQUIPMENT

1 Stoker Maintenance Data—"Fundamentals of Stoker Operation and Maintenance"—a booklet that sets forth fundamental facts concerning operation, lubrication, inspection and maintenance of stokers of all types is now available. Examples are given of oil fired boilers converted to coal firing. Included in the booklet is a technical paper, "Some Ways to Avoid High Stoker Maintenance." Combustion Engineering Co., Inc.

2 Fuel Burning Booklet—"Names That You Know" is the title of a new 12-pg Canton Stoker Corp. brochure. It contains a classified industry listing of principal Canton Stoker users, including boiler HP with number and types of stokers installed. Additional fuel-burning information and other interesting Canton Stoker facts complete this latest piece of literature.

3 Coal Crushers—Bulletin describes Bradford Breakers for reducing rom coal for stoker or pulverizer feed with no oversize and low overgrinding. Automatically eject tramp iron and mine debris; handle 25 to 500 tph. Pennsylvania Crusher Co.

4 Operating Guide for Single Retort Stokers—To help keep single retort stokers on the job, a new Operating Guide which contains operating and maintenance suggestions is announced by Westinghouse. The booklet gives hints regarding instruments, air requirements, operation, fuel distribution, ash and clinker, boiler and furnace structure, coal segregation, automatic regulation, steam drive, hydrofeed drive, link-gate stokers and stationary grate stokers. Westinghouse Electric and Manufacturing Co.

5 Coal and Ash Handling—Catalog 200-E describes latest methods of handling coal and ashes. Its many illustrations, tables, diagrams make it a source book of useful ideas for engineers and plant owners. Gifford-Wood Co.

6 Textbook On Furnace Walls—Those who have problems in heat enclosure will be interested in the new 80-pg Detrick textbook on suspended arches and walls. Many helpful suggestions are presented in charts and illustrations; text explains various constructions. M. H. Detrick Co.

7 Heavy-Duty Stokers—20-pg bulletin features Iron Fireman Poweram heavy-duty stokers for boilers developing up to 400 hp; outlines features of these stokers, shows actual installation photographs and lists representative users. Iron Fireman Mfg. Co.

7-B Furnace Wall Protection—Literature describes Brickseal, a semi-plastic monolithic coating that protects brick refractory linings against cracks when forced to undergo rapid changes in temperature. Can be sprayed or brushed on. Brickseal Refractory Co.

ELECTRICAL EQUIPMENT

8 Uni-Shell Motors—How all types of R & M electric motors are supplied in bodies of identical dimensions is described in new 20-pg booklet. Also tells about advances in bearing alignment, precision balanced rotors, better insulation and other motor improvements. Robbins & Myers, Inc.

9 Gear-Motors — G-E gear-motors are featured in a new 16-pg illustrated bulletin (GEA-1437D). It describes the many types of gear-motors now furnished by General Electric, lists their advantages, and indicates the various locations where their use is most desirable. Bulletin also contains descriptions of the mechanical features of these motors, the electrical characteristics of the polyphase motors which are integrally built into them, and charts showing their horsepower-speed ratings. General Electric Co.

10 Squirrel Cage Motors—Bulletin SCF-1 describes and illustrates the various enclosures and degrees of protection available for squirrel cage motors, ½-75 hp and internal constructional features. Crocker-Wheeler Electric Manufacturing Co., Division of Joshua Hendy Iron Works.

11 How To Make Magnets Lift More, Last Longer—Thirteen suggestions proved by experts, in simple clear language with graphic pictures telling just what to do and what not to do—this is given on an 8 in. by 20 in. card to be hung in the magnet crane cab. This card should help speed production, conserve critical material and manpower. Cutler-Hammer, Inc.

12 Primer on Electronic Tubes—Written primarily for industrial engineers is a new 24 pg. nontechnical book titled "How Electronic Tubes Work". Describes the eight basic types of industrial electronic tubes; contains 117 helpful sketches and photographs; describes many applications. General Electric Co.

FANS, PUMPS AND COMPRESSORS

13 Plain Talks On Compressors—A well illustrated 24-pg booklet "Plain Talks on Air and Gas Compressors" highlights for compressor users the basic principles which underlie the successful operation and maintenance of their equipment. Worthington Pump & Machinery Corp.

14 Wartime Care of Centrifugal Pumps — Abundantly illustrated, Allis-Chalmers' new maintenance handbook makes specific recommendations for putting pump care on a wartime basis. Applies to all makes. Sent free while supply lasts. Allis-Chalmers Mfg. Co.

15 Facts About Rotary Pumps—Bulletin 301 entitled "Facts About Rotary Pumps" shows diagram of operating cycle, construction details and lists of many liquids handled by Blackmer pumps. Blackmer Pump Co.

INSTRUMENTS AND CONTROLS

16 Electronic Level Controls—New illustrated 4-pg bulletin describes operation and applications of Photoswitch electronic level controls for all liquids and powders. Especially adaptable to boiler feedwater controls, high- and low-level pump control, low-level alarm and fuel cut-off. Photoswitch, Inc.

17 Meters for Steam, Liquids and Gas—Bulletin 200-4, 47 pg, describes use of flow meters wherever air or gas, liquid or steam, is produced and distributed. Interesting discussion of flow problems encountered in industry. Much technical and application detail. The Foxboro Co.

18 Internal Combustion Engine Controls—Handsomely illustrated 36-pg book tells how gas, gasoline and Diesel engines equipped with Synchro-Start controls are automatically started or stopped. Pictures applications in air ports, power plants, refrigeration plants, etc. Synchro-Start Products, Inc.

19 Motor Controls — GEA-4015 is simplified guide to selection and application of commonly used motor controls. Book lists standard controls and describes operation, discusses when to use magnetic and manual controls, and explains when reduced-voltage starting is necessary. General Electric Co.

List Items You Want On Handy Coupon On Following Page

20 **Flow Rate Meters**—A new two-section catalog entitled "The Theory of the Rotameter" and "Rotameter Capacities and Correction Factors" deals with history and development of area-type flow meters. Text includes many diagrams and illustrations; also portrays immunity of the Stabl-Vis Rotameter to viscosity changes over ranges encountered in industrial practice and the ability of this rotameter also to give accurate gravimetrical readings without effect of fluid density changes. Fischer & Porter Co.

21 **Recording Thermometers** — New Bulletin, No. T800, with 40 pg of useful and technical information on thermometry and thermometers has just been published. It describes the Bristol line of recording thermometers with considerable space given to the basic theory of the several types offered, as well as practical information regarding ranges, charts, bulbs, and tubing available. The Bristol Co.

MECHANICAL TRANSMISSION

22 **Bearing Metal Handbook**—8-pg bulletin describes various lead-base metals which have proved to be excellent substitutes for tin-base bearing metals. Also contains suggestions for best results in making and maintaining journal bearings, and a table of recommendations for selecting correct bearing metal for 135 different types of machinery. Magnolia Metal Co.

23 **Gear Data Book** — Combination catalog and gear data book, 72 pg, includes dimension tables for various gear types, as well as data on speed reducing units. motoreducers, and electric hoists. Also contains engineering data section. Philadelphia Gear Works.

24 **Low Power Drives**—Worm gear units for 3 in. and 3½-in. center distances are described in Leaflet E-1219. These gears are supplied for either top or bottom drive and in ratios from 3⅝ to 1 up to 60 to 1, and are intended particularly for the operation of low-power machinery, such as small mixers, dryers, automatic furnaces and ovens, churns, conveyors and elevators, mechanical stokers, etc. De Laval Steam Turbine Co.

PIPING VALVES AND FITTINGS

25 **Modernized Steam Traps**—Illustrated folder tells about the self cleaning vent, reversible valve and seat and other advantages of K-Master steam traps. Includes dimension table and other useful data. Kaye & MacDonald, Inc.

26 **New Template Book Aids Pipe Fitting** — A new 12-pg booklet, "Pipe Templates for Welded Fittings," tells how to fabricate fittings for welded piping installations by means of flame-cutting and welding. Although standard welding fittings are generally most economical, occasions do arise where it is best for a user to fabricate his own fittings. In such cases the methods outlined in this booklet will save guesswork and spoilage and will help assure efficient fabrication. Air Reduction Co.

27 **How to Know Valves Chart**—Simplicity is the keynote of the new "Recognition" chart which breaks down valves into four basic types—shows simple, visual line illustrations—explains what service the four types of valves perform—how they operate—and where valves are used. Two additional features of these charts are the flow characteristics of each valve and the symbol sketches shown. Printed on heavy cardboard, 9½ by 12¼ in., is ideal for posting. Reading-Pratt & Cady Div. of American Chain & Cable Co., Inc.

28 **Underground Pipe Conduit**—Less than 2% critical material is used in Therm-O-Tile underground pipe conduit. No bell joints; condensate pockets cannot form. Fully described in Bulletin 381. H. W. Porter & Co.

29 **Valve Re-Seating Tools**—"How to stop the dollars dripping from leaky faucets" is the theme of a folder telling about the use of Economy renewable seats and re-seating tools. Suggestions for faucet and valve maintenance should interest engineers and plant owners. The Economy Valve Seat Co.

30 **Handbook On Fabricated Piping.** Invasion barges and power plants, tank factories and paper mills, battleships and filling stations . . . . they all require fabricated piping—to convey gas, air, steam, oil and chemicals, or for construction purposes. An interesting and useful handbook has just been issued which covers the various ways in which fabricated piping can be used and lists present market prices for every conceivable kind and size. The Flori Pipe Co.

31 **Joint Tightness** — Handbook, 40 pg, tells how to make up tight threaded flanged and hub joints speedily, and to seal leaking joints by ingenious time-saving and money-saving repairs to plant equipment. Smooth-On Mfg. Co.

32 **Seamless Flexible Metal Hose**—Bulletin H-935 furnishes engineers with complete data covering the physical properties and other pertinent information. Containing many illustrations, cuts and diagrams, it is invaluable to engineer, designer, and specification man who uses metal hose. Eclipse Aviation Seamless Flexible Metal Hose, Philadelphia Div. of Bendix Aviation Corp.

33 **Manual of Welded Heat Exchanger Tubing.** The new "Manual of Welded Steel Tubing for Heat Exchanger and Condenser Use" furnishes useful information to manufacturers and users of all types of heat transfer equipment. To speed deliveries of tubing, suggestions are made as to the information which should be given when ordering. Manual also includes fabricating data and tables of tube properties, for use in calculating surface areas, carrying capacities, displacements, etc. Formed Steel Tube Institute.

WATER TREATMENT

34 **Water Conditioning System** — New bulletin describes the technical water conditioning system which provides individual formulas to fit every water type. Said to provide a special balance of water properties that overcome scale, foaming, pitting, corrosion, caustic embrittlement. Water Treatment Co. of America.

35 **Chemical Treatment of Boiler Water**—That is the title of Betz Technical Paper No. 84 which presents a helpful discussion of the causes of boiler scale, corrosion, carryover and embrittlement. Also deals with the applications and limitations of commercial chemicals employed for the correction of these difficulties. W. H. and L. D. Betz.

36 **Carbite Softener** — Bulletin 4021 describes the many uses of the newly developed carbonaceous zeolite softeners, particularly as pertains to the treatment of boiler feed water supplies. Also tells about the chemical reactions and general arrangement of the equipment, the results to be achieved and application to different water supplies, and other pertinent information that is of value to engineers. Cochrane Corp.

37 **Improved Proportioning Equipment**—New 8-pg bulletin tells about construction, operation and application of the improved Nelson chemical proportioning pump. Dependent only upon the pressure surges developed by a master reciprocating pump, this synchronized drive pump is otherwise entirely self-contained. Complete dimensions, capacities and operating data, together with a thorough discussion of the unique Nelson valve and packing construction, are presented. D. W. Haering & Co., Inc.

This coupon must be filled in completely in order to secure the literature you request. Please indicate only the bulletins you particularly desire. Pasting coupon on penny postcard saves you time and money.

SEPTEMBER, 1943

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MISCELLANEOUS

38 **Waste Heat Units**—Bulletin WH-100 tells how Maxim waste heat units combine silencing, spark arresting and the utilization of waste exhaust heat to produce steam or hot water. The Maxim Silencer Co.

39 **Engineering Progress** — Handsomely illustrated 64-pg book, with 212 photos and drawings, reviews 1942 progress made with Allis-Chalmers blowers and air compressors, steam turbines, motors, generators, switchgear, feedwater treatment and other power equipment. A handy reference book for engineers, technicians, executives in government aand business. Allis-Chalmers Manufacturing Co.

40 **Leather Packing Handbook**—Fundamentals of Hydraulics and Place for Packings—Leather and Compression Packings—Different Types of Leather Packings — Cup Leathers — U Leathers are among the subjects discussed in a new and helpful handbook issued by J. E. Rhoads & Sons.

41 **Insulating Varnish**—Valuable information on baking and vacuum impregnation of electrical units with insulating varnish is available in the new colorful 6-pg folder on Dolph's Synthite PG-1 clear baking varnish. As this varnish cures by heat-induced chemical polymerization, it will not resoften even under the heat developed by some types of units. John C. Dolph Co.

42 **Standard On Mineral Wool Insulation**—Published in booklet form is Commercial Standard CS105-43, Mineral Wool; Loose, Granulated or Felted Form, In Low-Temperature Installations. It covers both cold storage area and pipe line mineral wool insulation; also includes recommendations by engineers of the refrigeration field generally. Industrial Mineral Wool Institute.

43 **Tube and Hose Fittings** — The new Weatherhead Catalog Supplement, eight pages in all, is a cross section of five lines of piping products. First comes a showing of aviation tube, pipe, universal and hose fittings. The valves, fittings, and accessories manufactured for the refrigeration industry are described in another section. The Weatherhead Co.

44 **Vapor Cleaner**—New folder describes Dee Tee vapor cleaner for removing all worn lubricants, dirt, grit and moisture. Simplifies the work of cleaning machinery gear cases and enclosed transmissions, oil reservoirs and lines, heat exchangers, etc. Circo Products Co.

45 **Packing Selection Data** — Free book "Quaker Packing" contains data covering every packing need against steam, air, gas, water, oil, brine, ammonia, acid, gasoline, asphalt and tar products. Quick and easy recommendation tables will aid you in solving your packing problems. A copy should be in every engineer's library. Quaker Rubber Corp.

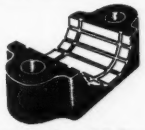
46 **Open Steel Flooring**—Many installation views, specification suggestions and table of safe loads for open steel flooring and steps are contained in new Bates Catalog No. 43-44. A valuable book for those planning strong, safe, clean floors for power houses and industrial plants. Walter Bates Co., Inc.

FIVE HINTS ON HOW TO MAKE

BETTER BEARING LININGS

Select the right bearing metal for the service, follow accepted methods of preparing the shell and pouring the metal, keep bearings well lubricated and free from dirt and your bearing troubles will become a thing of the past. While normal wear is to be expected, there is no excuse for cracked, squeezed and "frozen" bearings. The five points listed below have been found to be effective in helping to eliminate common causes of bearing failures.

1



Bearing shell should be absolutely clean...free of old metal, oil, dirt, scale and rust. All anchor holes and grooves should be well cleaned . . . by hand if necessary.

2

Pour bearing metal at the correct temperature . . . the pot should be pyrometer controlled for best results. Use only new metal; addition of scrap of a different formula will change characteristics of the babbitt.

3

Babbitt metals are mechanical mixtures and tend to separate if left alone. Stir over and over ...not around and around. To prevent cooling of metal in ladle, have pot and bearing close together.

4

Use a self-skimming ladle... large enough to hold all the metal needed to pour entire bearing at one time. Pouring too quickly prevents air in mold from escaping and causes blow holes or seams in lining.

5

Most important point of all is selection of bearing metal. 80% of bearings in use today are subject to uniform speed and only moderate pressure, as in electric motors, line shafting and general machinery. For such services, use Magnolia Anti-friction Metal.

When bearings must stand heavy, sustained pressures, such as in rolling-mill machinery, use Pyramid, a hard metal which will not squeeze out.

For shock loads, which would crack the harder metals, use Defender, a tough yet malleable metal. Internal combustion engines and trap rock crushers are typical applications.

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HEAVY LOADS

SHOCK LOADS

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...and easily... with these Fuel-Saving Baffles

- Provide cross-flow of gases over tubes for maximum heat-transfer
- Tapered gas passes and curved surfaces streamline the gas flow and maintain gas velocity for efficient heat-extraction
- Draft losses materially reduced by elimination of eddy currents, bottlenecks and dead gas pockets
- Less steam used in cleaning because soot blowers are used less often, and more effectively
- Applicable to any design of water-tube boiler, fired by any fuel
- Each installation is designed on the basis of 25 years experience in this specialized branch of engineering
- Installed by skilled mechanics

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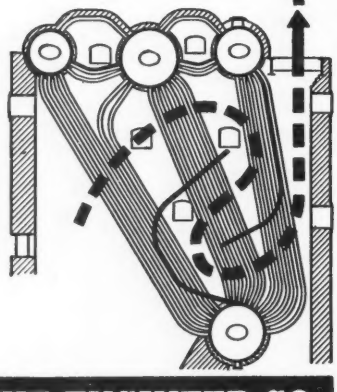

THE ENGINEER CO.
Enco 75 West St. New York, N. Y.

Bureau of Reclamation, Denver, Colo., has secured permission to install another generating unit at Grand Coulee hydroelectric power plant, Grand Coulee, Wash., comprising unit No. 7, to provide increase of 108,000 kw in present output. This project will be carried out at early date.

Pumping Stations to Cost $500,000

STANOLIND PIPE LINE CO., Philcade Building, Tulsa, Okla., has authorized extensions in four main pumping stations used for pipe line service in Northern Texas district, located at Cresson, Bowie, Grayford and Lakenon, respectively. Project will include installation of additional pumping machinery and auxiliary equipment for large increase in present booster service for main gasoline pipe line operation, and is reported to cost approximately $500,000. It is said that project will require close to 12 months for completion. Company office, Fair Building, Fort Worth, Tex., will supervise program. Company is a subsidiary of Stanolind Oil & Gas Co., same addresses noted.

Water Conference

THE FOURTH ANNUAL WATER CONFERENCE of the Engineers' Society of Western Pennsylvania will be held at Hotel William Penn, Pittsburgh, Pa., November 1-2, 1943. Tentative program of papers to be presented at the Conference is, New Methods of Testing Oxygen in Boiler Feedwaters in the Presence of Nitrites by Harold Staley, Cochrane Corp., Philadelphia, Pa.; Approval Testing of Naval Deaerating Feedwater Heaters by R. C. Adams, Naval Experiment Station, Annapolis, Md.; Paper on Corrosion (Title later) by L. F. Collins, Detroit Edison Co., Detroit, Mich.; Anaerobic Corrosion by A. E. Griffin, Wallace & Tiernan Co., Newark, N. J.; Development in the Application of Geophysics to Ground Water Problems by Dr. Carl A. Bays, Illinois State Geological Survey, Urbana, Ill.; The Treatment of Cooling Waters by L. Drew Betz, W. H. & L. D. Betz Co., Philadelphia, Pa.; Experimental Studies of Boiler Scale by J. A. Holmes, National Aluminate Corp., Chicago, Ill.; Paper by E. W. Scarritt, Elgin Softener Corp., Elgin, Ill.; Operating Data on Accelerator Softeners and Clarifiers by A. C. Embshoff, Infilco Co., Chicago, Ill.; Paper by J. J. Felsecker, Graver Tank & Mfg. Co., East Chicago, Ind.; and Latest Developments in the Removal of Cations and Anions from Water by Demineralizing by H. L. Tiger, The Permutit Co., New York, N. Y.

Joint Fuels Conference

THE JOINT FUELS CONFERENCE of the American Institute of Mining Engineers and American Society of Mechanical Engineers to be held at the William Penn Hotel, Pittsburgh, Pa., on Thursday and Friday, October 28 and 29, will include the following: four technical sessions: Coal Research, Mining Management, Oil and Gas, and the War Program as it pertains to fuels. "Coal Faces Post-War Adjustment" by R. M. Weidenhammer of Brooking Institute, and "Laboratory and Field Tests on Coal-in-Oil Fuels" by J. F. Barkley and L. R. Burdick of the U. S. Bureau of Mines and A. B. Hersberger of Atlantic Refining Company, are only two of the many papers included in the program.

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Keep on striking while the Iron is hot

The continuous, tremendous blows that the Allies are delivering daily will some day accomplish what we are all longing for—the end of the War.

It is imperative that there be no loss of effort by Industry anywhere. Let every worker realize the necessity of giving full effort every working day to keep the arms, munitions, food and all supplies moving constantly to wherever our Armed Forces need them.

INDUSTRIAL RUBBER GOODS

Have you ever seen a list of rubber articles that is necessary to keep the vast War machine in smooth operation? Surely a most imposing one.

The Rubber Manufacturers, by their whole-hearted effort and an initiativeness that is unparalleled, have an Industry that is turning out vast supplies which, until a short time ago, would have been considered impossible.

Various officials of many branches of the Government have recognized and acknowledged the magnificent part the Rubber Industry is taking in the War Program.

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This Trade Mark is back of all Quaker Quality Industrial Rubber Products: Rubber Belting, Hose for every conceivable purpose, Rod and Sheet Packings and Moulded Items.

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When Industrial Rubber Goods are required, consult Quaker. Constant touch by our special representative in Washington keeps us fully informed in these days of rapidly changing conditions. If there is a way to get it done Quaker will do it.

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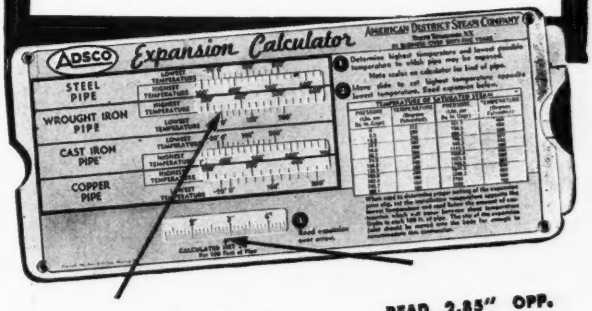
● **A simple, time-saving slide rule that shows expansion in 100 feet of pipe—for various materials and temperature ranges. Abbreviated steam table printed on face of calculator. No computations necessary — no handbooks — no chance of errors.**

HERE'S HOW IT WORKS

Example **How to find expansion in 140 feet Wrought Iron Pipe with highest temperature corresponding to 100 lbs. steam pressure (by gauge) and lowest temperature 0°.**

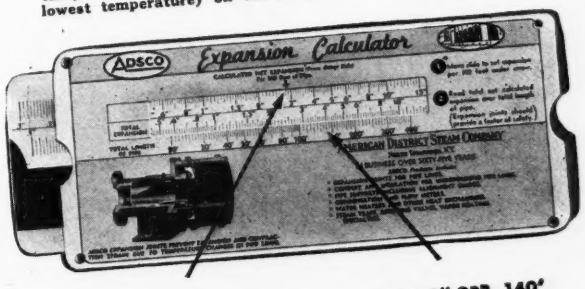


SET 3.40° OPP. 0°

Temperatures corresponding to 100 lbs. is a little less than 340° (340° = 103.3 lbs.) Set 340° (the highest temperature) on the slide opposite 0° (the lowest temperature) on the body.

READ 2.85" OPP. ARROW

Slot at bottom, opposite arrow reads 2.85 per 100 feet of pipe.



SET 2.85" OPP. ARROW

READ 4" OPP. 140° LENGTH

Turn calculator over. Set 2.85" (the expansion per 100 feet) on the slide opposite the arrow. Column marked "Total Expansion" reads 4" for 140 feet.

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NEW ENGINEERING BOOKS

Industrial Chemistry. By Emil R. Riegel. Size 6 by 9 in., 861 pp, cloth binding. Published, 1943, by Reinhold Publishing Corp., 330 W. 42nd St., New York, N. Y. Price $5.50.

Preparation of the text for the fourth edition of this splendid book fell within the present war period. Nevertheless, because of the cooperation of those consulted for specialized information, not a single project had to be abandoned for lack of reply. The book, according to its subtitle, is an elementary treatise for the student and general reader and should prove invaluable to any engineer not a chemist who needs information about the various chemical processes employed in all industries, the products resulting from them and the general principles and apparatus employed in producing them. The book is very well illustrated with diagrams of apparatus, interesting photographs, charts and maps of mineral or chemical deposits.

The general scheme of the book in the fourth edition is unchanged. Two chapters have been rewritten, those on paper and pulp and on synthetic textile fibers. The chapter on Portland cement has been brought up to date by a thorough revision. The chapter on rubber includes the new developments in synthetic rubbers as well as the latest advances in working natural rubber. The many innovations in petroleum technology called for much space, so that clear and adequate statements on aviation gasoline, on alkylation, on the Houdry catalytic process and other topics could be included. The bottleneck in our TNT manufacture, says the author, will not again be toluene, thanks in part to the process of hydroforming petroleum fractions.

Space is lacking for a complete list of the chapters, but they cover such interesting subjects as: Fuels; radium; acids; distillation of hard wood; processes based on the activity of yeasts and bacteria; petroleum and its products; photographic plates, films and papers and so on. There are interesting chapters on appliances used by the chemical engineer, on instruments of control, materials of construction, and on the well-known and commonly-used metals.

Contributions to the Metallurgy of Steel—No. 10. Size 6 by 9 in.; 76 pp; paper bound. Published, 1943, by the American Iron and Steel Institute, 350 Fifth Ave., New York, N. Y.

As a means of further conserving chromium, nickel and molybdenum, and to make the most complete use of the quantity of those elements derived from scrap, the NE 9400, 9500 and 9600 series of steels were formulated and adopted in the latter part of 1942. These steels have already taken their place in the melting schedules of the steel producing plants and in the users' specifications. A considerable tonnage, particularly of the 9400 series, has already been made and used with most satisfactory results.

In order to accumulate certain mechanical property data concerning these steels as promptly as possible, the members of the Technical Committee on Alloy Steel of the American Iron and Steel Institute inaugurated a cooperative program involving the making and testing of heats representing the most popular carbon ranges of the new steels. The results of this program are reported in this booklet. In order to expedite the program as much as possible, it was necessary to confine the work to 300-lb electric arc furnace heats, as it was impossible to secure commercial open hearth or electric furnace heats in all of the grades desired. Consequently, nine heats representing NE 9420, 9430, 9440, 9442, 9540, 9630, 9640, 9642, 9650 were melted in a 300-lb arc furnace. The ingots were forged to 4 by 4 in. billets and subsequently rolled into 1¼ and ⅝ in. squares and tested.

The Committee points out that the data presented in this book are only single heat results and are intended to show only approximate properties.

The Engineer's Manual of English. By Sypherd, Fountain and Brown. Size 5 by 7½ in., 503 pp, cloth bound. Published, 1943, by Scott-Foresman & Co., 623 South Wabash Ave., Chicago, Ill. Price $2.50.

In this revised edition of a book familiar to the present generation of engineers, every attempt has been made to bring it up to date and incorporate practical illustrative examples and other material. The book was originally written to serve both as a textbook for engineering college students and as a reference book on usage for practicing engineers.

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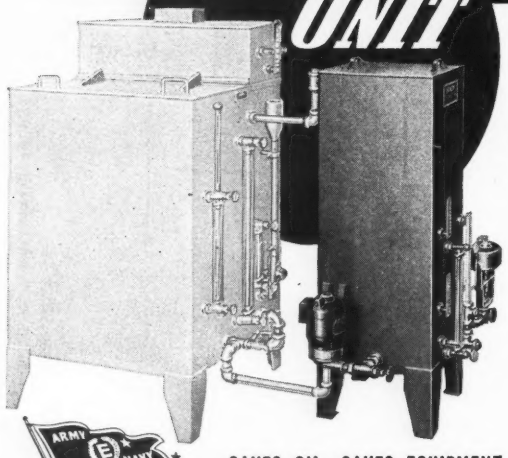

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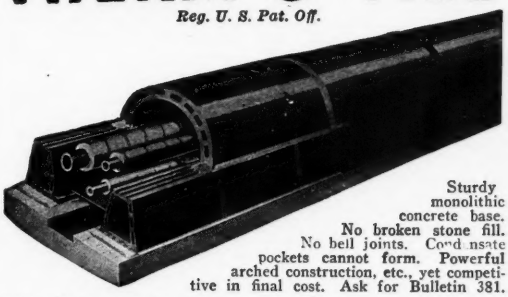

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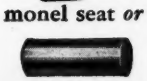

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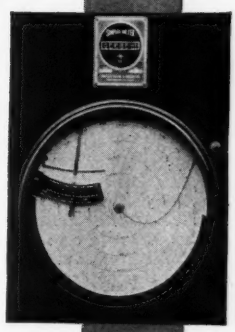
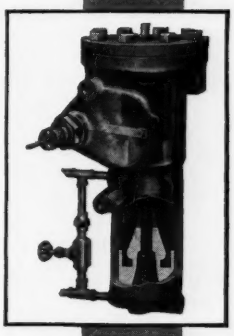


Type MS Meters for service as a flow indicator, recorder, indicator and recorder, indicator and totalizor, recorder and totalizor, or indicator, recorder and totalizor.



Bell-shaped float is sensitive to smallest change in diff. pressure and directly transfers it to pen, pointer, and totalizer.

SIMPLEX METERS

THE METER WITH THE BELL SHAPED FLOAT

Books for such a double purpose are always difficult to write, for the undergraduate engineering student must always be trained in expressing his ideas, whereas he does not have very much to express, while, on the other hand, the practicing engineer must be concerned primarily with the technical content of what he has to say. Furthermore, and especially in regard to his letters, technical articles, bulletins, and the like, the engineer frequently finds that a number of other people have something to say about the way he expresses technical facts.

However, despite this difficulty, the revised edition of this book comes closer to hitting both targets than a number of others we have seen.

The first chapter, on general problems, discusses objectivity in technical writing, adaptation to reader, steps in preparation, devices for documentation. This includes some good comments on taking notes, use of indexes, handbooks and magazines and similar details. Elements of the whole composition, that is paragraphs, sentences and words, are discussed in detail in Chapter 2. Mechanical details, such as punctuation, use of technical abbreviations, hyphenation, writing of numbers and uses of capitals are described in Chapter 3. Chapter 4 is devoted entirely to the details of correspondence, and Chapter 5 to report writing.

In Chapter 6 on writing for technical journals, some good typical examples are given of various types of writing found in recent publications. The comments on how to do it are sound enough as far as they go. But, on the whole, they fail to tell a practicing engineer most of the things he needs to know for this purpose. They would, however, help the undergraduate student.

There are good chapters on specifications and patents and a chapter on the writing of bulletins and catalogs. Preparation of the latter depends so much on the particular policies of an individual company, and the way in which its sales and advertising organizations prepare its technical literature, that it is difficult to be specific about this subject.

This writer was much pleased to note that in the chapter on public speaking, Appendix B, this book highly recommends a study of Professor S. Marion Tucker's fine book, Public Speaking for Technical Men. We wish that caution had also been given against one of the principal faults of engineering speakers and writers; namely, "back-to-the-amoeba" introduction.—C.R.E.

Hardness. By D. Landau; 1943; first edition. Size 6 by 9 in.; 105 pp; paper bound. Published by the Nitralloy Corp., 230 Park Ave., New York City. Sent free to interested persons.

In this book the author, who is industrial applications engineer for the Nitralloy Corp., gives a critical explanation of hardness, dynamic hardness, and endeavors to reduce the quality of material known as hardness to dimensional analysis. Starting his treatise with an historical sketch regarding the discovery of this quality of hardness, the author quickly gets into a discussion of definitions and methods of measuring variations in hardness of metals and describes a number of experiments from which he draws conclusions regarding the relationship between energy of impact, deformation, elastic reaction, speed of detent of the metal, rebound speed, and the dynamic hardness of the metal. The book is largely one of definitions of terms used in the science of testing for hardness interspersed with descriptions of testing equipment and methods. In his conclusion, the author laments that the engineer-physicist is still waiting for the complete solution of the problem of explaining just what hardness is. This is a book that any engineer desirous of knowing the whys and wherefores of hardness of metals will enjoy reading.

Diesel and Gas Engine Power Plants. By Glenn C. Boyer. Size 6 by 9 in.; 447 pp; cloth bound. Published, 1943, by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York City. Price $4.00.

For a number of years there has been a great need for a book such as this. As its title indicates, it deals primarily with Diesel and gas engine power plants rather than with the details of the engines themselves.

It is written primarily for the designer and operator of Diesel and gas engine power plants from material used for many years by the author in his professional work as a consulting engineer. It does, of course, discuss some engine details but only as necessary to the understanding of the plant as a whole. It is far more than a description of engine details and is in

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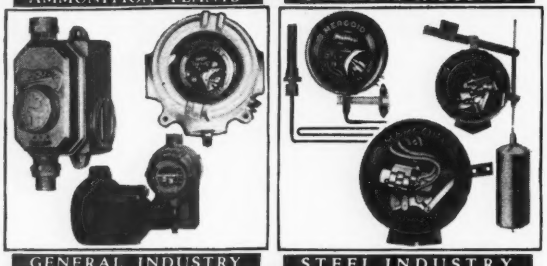

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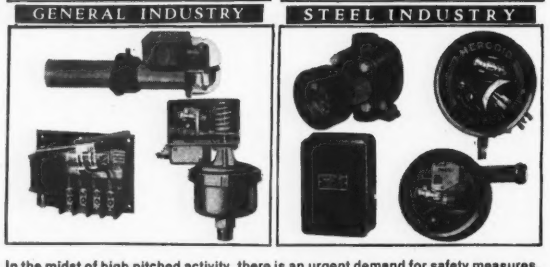

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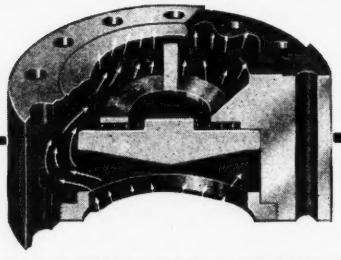

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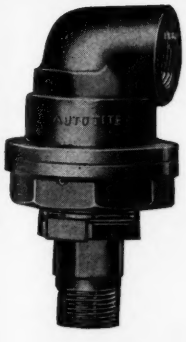

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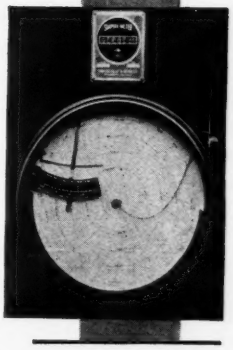
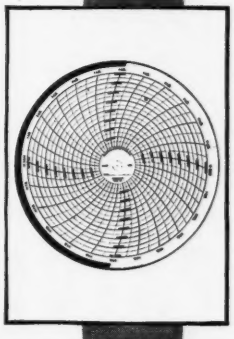


MS meters can be set up as indicator; recorder; indicator and recorder; indicator and totalizor; recorder and totalizor; or indicator, recorder, or totalizor.



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SIMPLEX METERS

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reality a working manual for the plant designer. Many nomographic charts and short-cut procedures have been incorporated to simplify calculations and involved mathematical treatment has been purposely eliminated.

After a general introduction discussing the general characteristics of Diesel and gas engine plants, the author discusses variable loads in power plants, power plant performance, economic studies. Then follow chapters on the industrial power plant, pipe-line pumping stations, the power plant building, and selecting the engine. Remaining chapters discuss fuel oil, gas fuel, lubrication, engine cooling, intake and exhaust systems, piping systems, waste heat recovery, accessories, maintenance, electrical equipment and electrical system layouts. The final chapter covers equipment testing.

This book should be of the highest value to the power plant designer because it is talking about the most modern practice from the point of view of one who actually uses it. It should also be of great value to operators of Diesel plants in showing them the relation between various components of their plants.

Wherever bibliographies of the latest texts and articles would be useful, they are inserted at the end of the various chapters.

Dictionary of Science and Technology. By Maxim Newmark. Size 6 by 9 in.; 386 pp; cloth bound. Published, 1943, by Philosophical Library, Inc., 15 East 40th St., New York, N. Y. Price $6.00.

Here is another of the recent books, like Mayer's Chemical-Technical Dictionary noted in our April issue, that are dictionaries in a limited sense only, because they provide the equivalent of a word in several languages but do not define the word itself. In this particular dictionary the words are first indexed in English, followed by their French, German and Spanish equivalents. The book contains 10,000 current terms in the English language most frequently used in the physical sciences and their applied fields, together with separate indices in French, German and Spanish, conversion tables and technical abbreviations.

For example, in the main section of the book, looking up superheater we find it followed by *surchauffeur* (French), *Uberhitzer* (German) and *sobrecalentador* (Spanish), each of these being listed in the appropriate index in the back of the book. This book should prove valuable for engineers and others in business, particularly at the present time, in translating technical and scientific terms.

Loss of Head in Flow of Fluids Through Various Types of 1½ In. Valves—Bulletin No. 24. By Wallace M. Lansford. Price 40 ct.

Effect of Cold Drawing on Mechanical Properties of Welded Steel Tubing—Bulletin No. 27. By Winston E. Black. Price 40 ct.

Pressure Losses in Registers and Stackheads in Forced Warm-Air Heating—Bulletin No. 32. By Alonzo P. Kratz and Seichi Konzo. Price 65 ct.

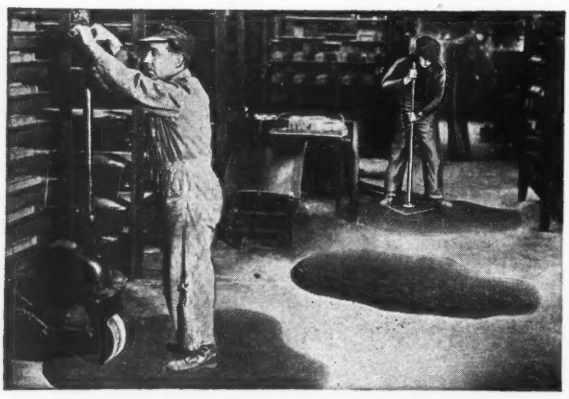
Tests of Composite Timber and Concrete Beams—Bulletin No. 38. By Frank E. Richart and Clarance B. Williams, Jr. Price 65 ct.

These four bulletins, each 6 by 9 in., have been published during 1943 by the University of Illinois Engineering Experiment Station, Urbana, Ill., as a result of investigations in the laboratories of that institution. In each of the bulletins is given the object and scope of the investigation, a detailed description of the method of testing, results secured by the test, and a discussion of these results. They have all been prepared and released by the University as authentic information on the subjects treated and should be found helpful in solving many design and operating problems.

Proceedings of the Midwest Power Conference. Volume VI, 1943, 6 by 9 in., 232 pp; paper bound. Published by the Midwest Power Conference through its sponsor, the Illinois Institute of Technology, 3300 Federal St., Chicago, Ill. Price $2.00.

These proceedings contain all the addresses and papers presented at the Midwest Power Conference held in Chicago in April, 1943, together with the complete registration list.

Altogether 29 papers appear in the proceedings which may be grouped under such general headings as: Power plant practice, electrical distribution, industrial power plants, plant protection, plant maintenance, Diesel power, fuels and combustion, and army engineering.



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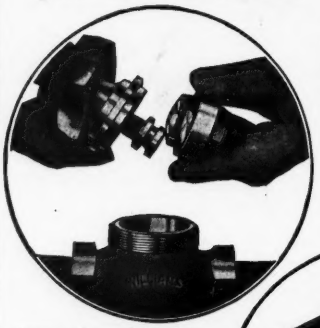

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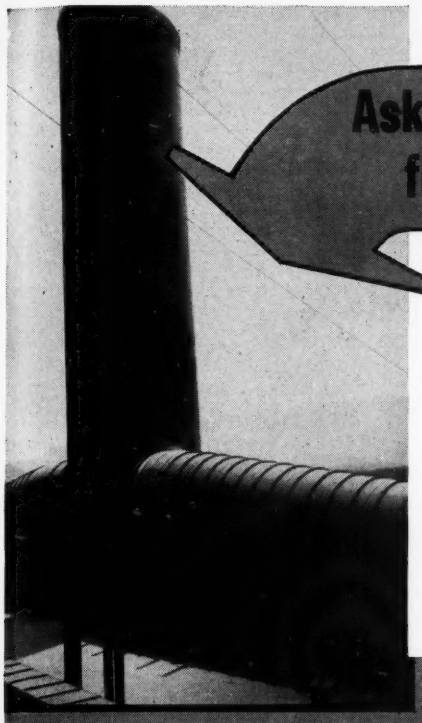

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5 Reasons Why We Measure Our Valuable Stored Liquids With

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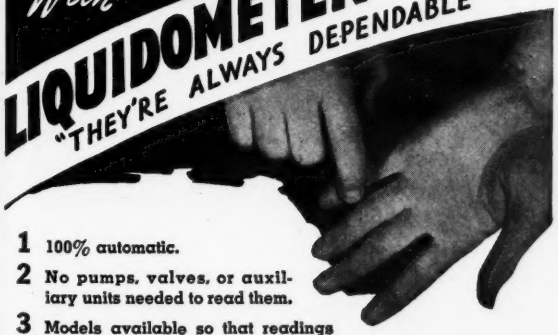
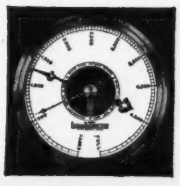


1. 100% automatic.
2. No pumps, valves, or auxiliary units needed to read them.
3. Models available so that readings can be taken remotely from or directly at the tank.
4. Accuracy unaffected by specific gravity of tank liquid.
5. Approved for gauging hazardous liquids by Underwriters' Laboratories and other similar groups.



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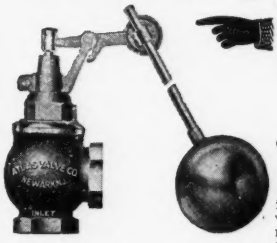

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For that reason it is superior in every way to ordinary float valves. The float shown here merely "Pushes a Button" and then SUPPLY PRESSURE does the actual heavy work of valve manipulation. It is guaranteed to be positively drop tight.

Angle, Fig. 214.
Globe, Fig. 214a.

The auxiliary valve does not have to move more than ¼ in. to open fully or close the main valve. Result: Extremely sensitive and accurate operation. Can be installed within the tank or in the supply line outside the tank and operated by a float in the tank. Strong and durable. Sizes ½" to 10". Globe or angle. Screwed or flanged. Complete data on request.

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Power Plant Construction News

Ala., Decatur—Goodyear Decatur Mills, manufacturer of tire fabrics, a subsidiary of Goodyear Tire & Rubber Co., Akron, Ohio, plans installation of electric power equipment in new one-story addition, about 280x520 ft. Cost reported over $800,000, with machinery. Erection will begin soon.

Ariz., Phoenix—Goodyear Aircraft Corp., Litcheld Park, Phoenix, manufacturer of airplane products, plans installation of electric power equipment in one-story addition, about 220x250 ft, for which superstructure will begin soon. Cost reported over $500,000. Company is a subsidiary of Goodyear Tire & Rubber Co., Akron, Ohio.

Calif., Los Angeles—Western Gear Works, 2600 East Imperial Highway, Lynwood, Los Angeles, manufacturer of gears, transmissions, etc., plans installation of electric power equipment in connection with expansion in local plant for increased production for Government. Cost estimated about $350,000, with financing by Defense Plant Corp., Washington, D. C., Federal agency. Main offices of company are at 417 Ninth St., South, Seattle, Wash.

Ill., Hines—United States Engineer Office, War Department, 222 North Bank Dr., Chicago, Ill., has plans for new boiler house for Area C, at recently completed addition to Hines hospital, Hines. It is understood that bids will be asked soon. A. Epstein, 2001 West Pershing Rd, Chicago, is engineer. No estimate of cost announced.

Iowa, Cherokee—Farmers' Produce Co., Cherokee, plans boiler house in connection with proposed new one-story poultry processing and packing plant on local site, now being selected. Power equipment will be installed for plant service. Entire project is reported to cost close to $50,000. William Buettler, Insurance Exchange Building, Sioux City, Iowa, is architect.

Md., Baltimore—Hinde & Dauch Paper Co., 3400 East Biddle St., manufacturer of corrugated boxes and containers, has approved plans for one-story addition to boiler house at plant, to include installation of additional equipment for increased capacity. No estimate of cost announced.

Mass., Boston—Meisel Press Mfg. Co., 944 Dorchester Ave., now in production for Government, will carry out expansion in plant, with installation of machinery and electric power equipment for considerable increased output. Cost estimated about $150,000, with financing provided by Defense Plant Corp., Washington, D. C., Federal agency, in that amount.

Mich., Wyandotte — Pennsylvania Salt Mfg. Co., Wyandotte, plans installation of electric power equipment in connection with proposed rebuilding of portion of chemical works at Wyandotte, recently destroyed by fire, with loss reported in excess of $400,000. Main offices are in Widener Building, Philadelphia, Pa.

Minn., Winona — Northwest Flax Industries, Inc., John A. Johnson, president, Winona, plans installation of electric power equipment at new flax-straw processing mill on local site, for production for Government. A boiler house is planned. Entire project will cost about $215,000, with financing provided by Defense Plant Corp., Washington, D. C., Federal agency. Work will be placed under way soon.

Mo., St. Louis—Department of Public Utilities, City Hall, Max H. Doyne, director, plans new steam power plant at Chain-of-Rocks pumping station, with installation of boilers, pumps and auxiliary equipment for large capacity. Cost reported over $900,000. Additional pumping machinery and auxiliaries are planned at Howard Bend pumping station, to increase output of plant by about 60,000,000 gal per day. Cost estimated approximately $350,000. This is part of a general expansion and improvement program for water system, to cost about $2,800,000.

Mo., Springfield — Domino Macaroni Co., Springfield, plans installation of electric power equipment in connection with proposed rebuilding of processing and packing plant, recently destroyed by fire, with loss reported close to $100,000, including machinery.

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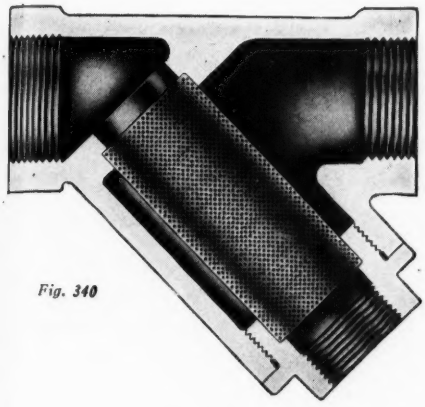

Fig. 340

War has curtailed our civilian manufacturing—and multiplied the difficulties of your job. But don't let it get you down. If you have a problem involving pressure or fluid control—an installation, operating or maintenance problem—we can save you days of work and worry. Call on our new VALVE PROBLEMS CLINIC. All the know-how of 65 years of specialization is yours for the asking . . . no charge, no obligation, no red tape. Whether or not you are using K & M equipment . . . we invite you to **CALL ON K & M.**

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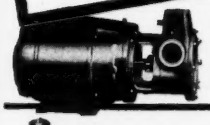
There is a size and type of Westco unit to meet important water moving requirements in practically every industry. Among the wide range of Westco equipment, the following are typical:



THE WESTCO UNIBILT PUMP

. . . an extremely compact, rugged pump for general purpose applications at low and medium heads. Ideal as sump pump, pressure pump, circulating pump, etc., where space is a limitation. Capacities to 100 GPM. Heads to 300 ft. Both self-priming and non-self priming types.

THE WESTCO FLEXIBLE COUPLING PUMP

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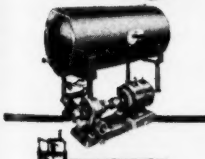
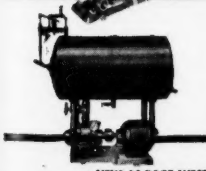


WESTCO CONDENSATE RETURN UNIT

. . . returns condensate to boiler at highest possible temperature, effecting important fuel savings. Automatically compensates for extreme head variations, assuring positive return against fluctuating pressures. Compact, rugged. Sizes to 100,000 sq. ft. of radiation. Pressures to 150 lbs.



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. . . insures uniformly-even boiler feed to maintain highest possible boiler temperatures with minimum firing. Automatically maintains uniform water level and steam space in the boiler, increasing boiler efficiency. Internal Make-up type for boilers to 25 HP. External Make-up for boilers to 750 HP.

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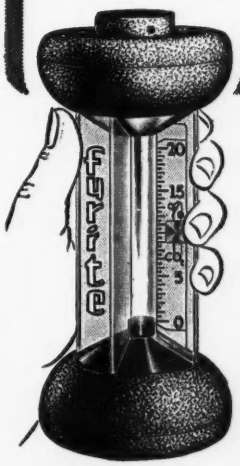

The FYRITE instantly reveals stack loss—the greatest loss in the conversion of heat energy of the fuel to heat energy in the steam. It is accurate within ½ of 1% CO_2. The FYRITE is simple and rugged—has no valves, clamps, or leveling bottle; no glass parts or batteries. It is spill-proof, cold-weather proof. More than 7000 are in use.

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Address

City State PP

Neb., Omaha—Farm Crops Processing Corp., Fourth and Jones Sts., Alvin E. Johnson, secretary-treasurer, plans installation of electric power equipment in new additions to commercial alcohol plant at location noted, for increased production for Government. Cost estimated about $1,100,000, with financing provided by Defense Plant Corp., Washington, D. C., Federal agency. Work will be carried out at early date.

N. J., Hoboken—Bethlehem Steel Co., Shipbuilding Division, foot of 14th St., has approved plans for new boiler house at local yards, estimated to cost over $50,000, with boilers and auxiliary equipment. Work will be placed under way at once. Lockwood, Greene Engineers, Inc., 10 Rockefeller Plaza, New York, N. Y., is consulting engineer.

N. Y., College Point—Edo Aircraft Corp., College Point, manufacturer of airplane specialties, will make extensions in plant for production for Government, with installation of machinery and electric power equipment for increased output. Cost estimated about $100,000, with financing by Defense Plant Corp., Washington, D. C., Federal agency. Program scheduled to begin soon.

N. Y., Jamestown—American Aviation Corp., Jamestown Municipal Airport, manufacturer of plywood aircraft, now in production for Government, plans new boiler house in connection with expansion in plant, with installation of boilers, pumps and auxiliary equipment. Program will include three other buildings, totaling over 100,000 sq ft floor space. Electric power equipment will be installed. Cost estimated about $950,000, with financing by Defense Plant Corp., Washington, D. C., Federal agency. Beck & Tinkham, Bailey Building, Jamestown, are architects.

R. I., Central Falls—General Products Co., 86 Hadwin St., manufacturer of plastic products, plans installation of electric power equipment in new two-story addition. Cost estimated close to $50,000, with machinery. Dwight Seabury Co., 188 Main St., Pawtucket, R. I., is architect.

Texas, Texas City—Gulf Oil Corp., Gulf Building, Houston, Texas, plans extensions and improvements in five pumping plants used for oil pipe line service in vicinity of Texas City, including installation of pumping equipment and accessories for increased capacity. Cost reported close to $100,000.

Texas—War Department, Washington, D. C., has plans under way for new army air force base in Bexar County, exact location not announced, including hangars, shops and other industrial buildings. Electric power equipment will be installed. Also will install power substation, distribution lines and other electrical facilities. It is understood that a refrigerating plant will be built. Entire project will cost over $1,000,000, and will be carried out under supervision of U. S. District Engineer Office, San Antonio, Texas.

Vt., Burlington — Bell Aircraft Corp., 2050 Elmwood Ave., Buffalo, N. Y., manufacturer of military airplanes, has acquired a former textile mill at Burlington, and will remodel and equip for new plant for manufacture of special aircraft equipment for Government. Property consists of a group of buildings, totaling 250,000 sq ft of floor space, and will be developed for large output. Electric power equipment will be installed. Cost estimated about $2,000,000, with financing provided by Defense Plant Corp., Washington, D. C., Federal agency. Proposed to carry out work at once.

W. Va., Cabincreek — Appalachian Electric Power Co., Charleston, W. Va., has plans maturing for alterations and improvements in steam-electric generating station at Cabincreek, and will begin work at early date. No estimate of cost has been announced.

Wis., Appleton — Wisconsin-Michigan Power Co., 137 West Mill St., Appleton, is considering installation of a new water-gas generating set for expansion in artificial gas plant, including complete auxiliary equipment. No estimate of cost announced. Application has been made for permission.

Wis., Appleton—Wisconsin Rendering Co., Appleton, manufacturer of tallow, greases, etc., plans installation of electric power equipment in connection with proposed rebuilding of plant, recently destroyed by fire, with loss reported at close to $90,000, with machinery.

Wis., Cudahy—Ladish Drop Forge Co., Cudahy, manufacturer of steel forgings, will carry out expansion in plant for production for Government, including additional buildings and installation of machinery and electric power equipment for considerably increased output. Entire program will cost about $1,200,000, with financing provided by Defense Plant Corp., Washington, D. C., Federal agency. Work will proceed at early date.

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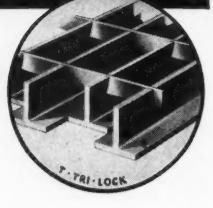

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With a

VIBRATAP CLEANER

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Now is the time to clean boiler tubes and save fuel, restore a boiler's steaming capacity. Write for Bulletin V-9.

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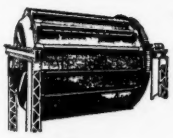

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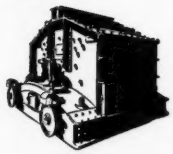
Reduce R.O.M. for Stoker or Pulverizer feed with absolutely no oversize and low "over-grinding." Crush by *gravity-impact*. Automatically eject, without damage, tramp iron, mine debris and hard rock. Low H. P. . . . slow speed . . . long life. Low upkeep . . . rugged . . . thoroughly dependable. 25 to 500 T.P.H. Steelbuilt. Patented.



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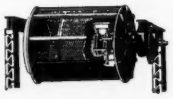

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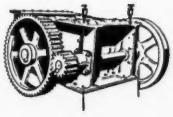

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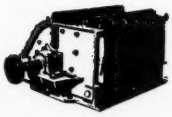

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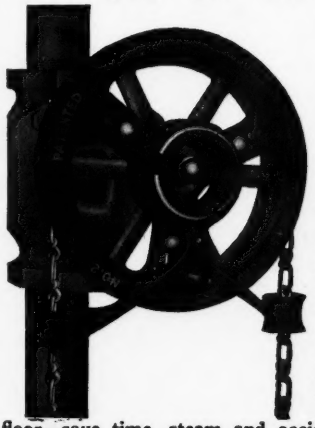

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Babbitt Rims give you instant and positive control of overhead valves from the floor—save time, steam and accidents. Adjustable to any valve, easily attached and low in cost. Don't delay. Get your Babbitt Rims now! Complete information on request.

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SPROCKET RIM
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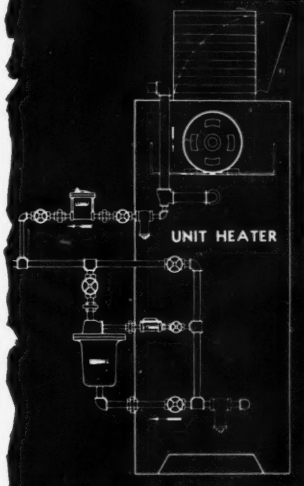
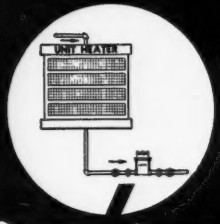
MORE HEAT·FASTER WITH LESS FUEL!



FLOOR-TYPE HEATER with Strong 70 Series trap draining inlet line, and 80 Series with Thermal Air Valve draining heater. Note strainers ahead of traps. OVERHEAD HEATER (circle) drained by Strong 70-T trap, with built-in thermal vent.



Accumulated condensate and trapped air can make unit heaters slow in starting. Uncertain drainage can seriously reduce heat output.

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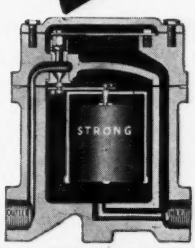
While all Strong Inverted Bucket Traps will handle large amounts of air, the hookups shown here provide thermal air vents for practically instantaneous heating. Use of Strong anti-balancing traps, guaranteed for a year against leakage, insures positive drainage without waste of steam.



Strong 70-T trap with built-in bi-metal air vent. For saturated steam pressures to 150 p.s.i.

. . .

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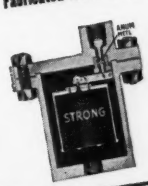
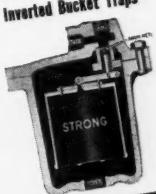


Inverted Bucket Traps



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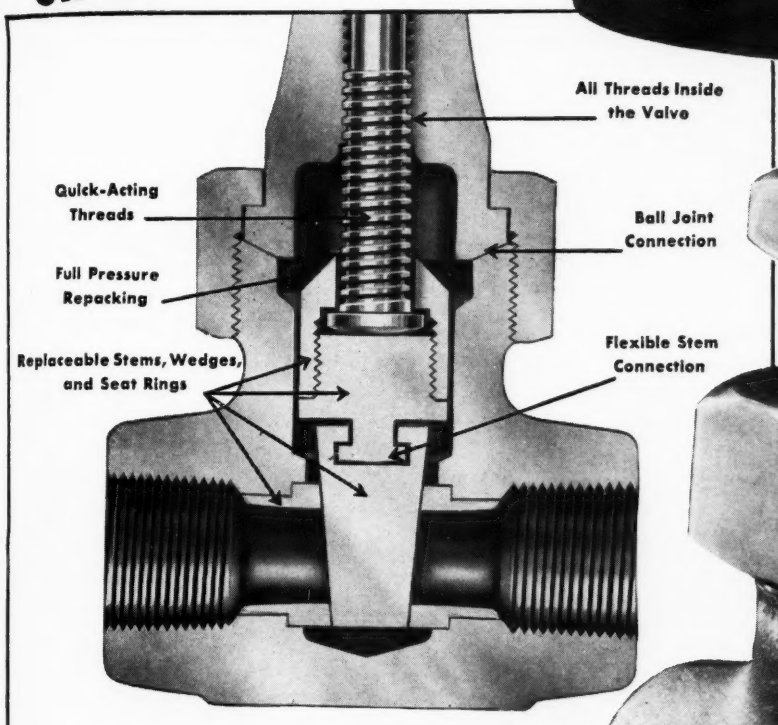

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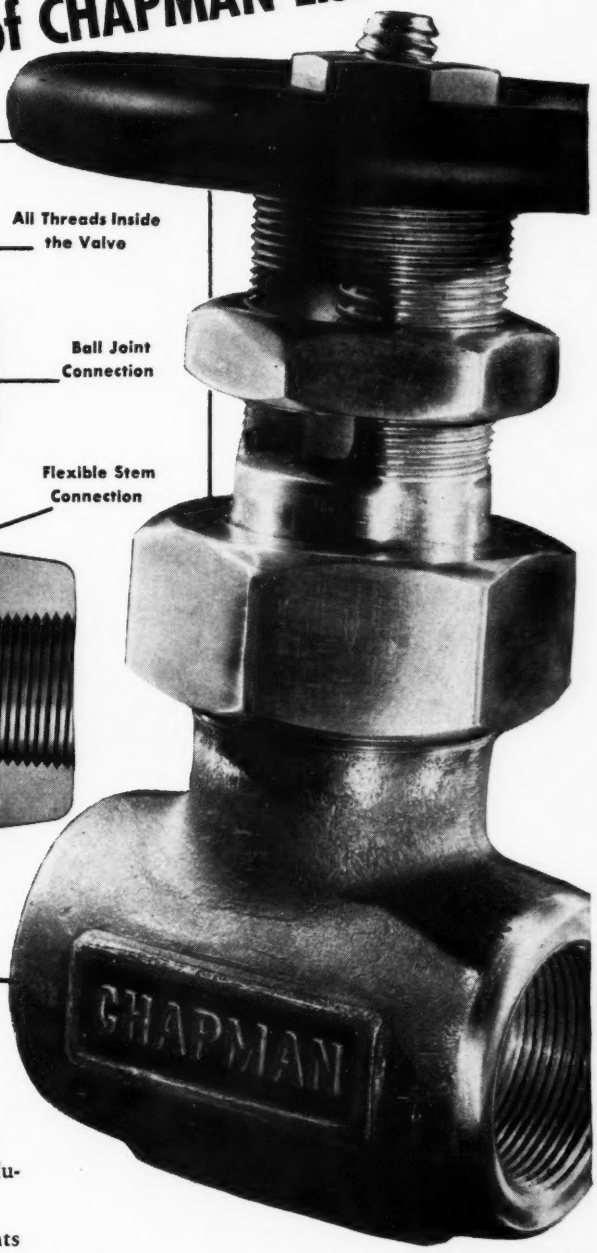

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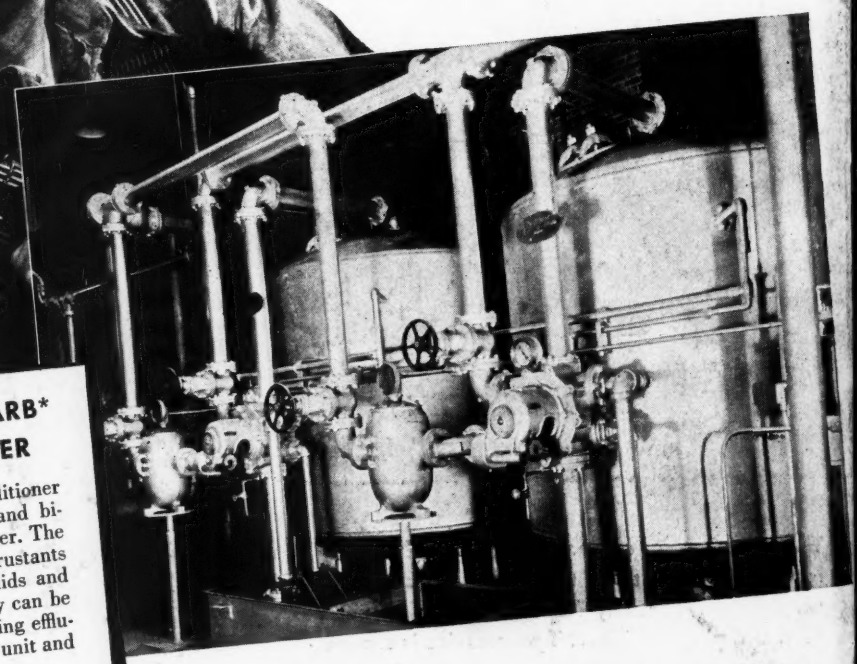

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